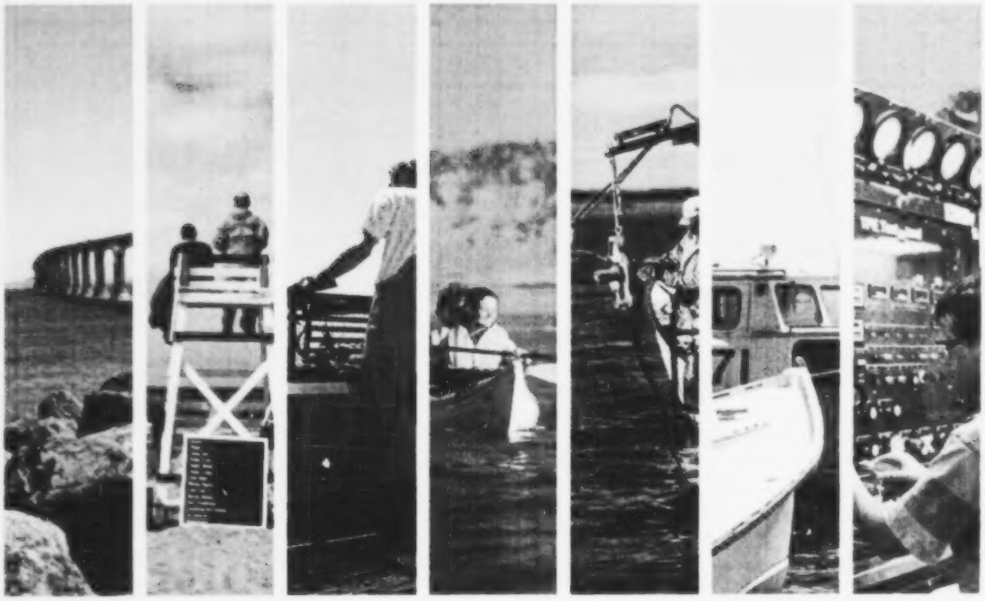
The Value of the Ocean Sector to the Economy of Prince Edward Island



Province of Prince Edward Island

March 2002

Prince Edward Island

Canada

The Value of the Ocean Sector to the Economy of Prince Edward Island

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Executive Summary

The Value of the Ocean Sector to the Economy of Prince Edward Island

The principal aim of this study was to estimate the importance of the ocean sector to the economy of Prince Edward Island, and to evaluate the methods and estimation procedures which were used to measure their impact. The second aim was to consider the application of environmental economics to the ocean sector by examining the methodologies which reconcile the environment and the economy.

The ocean sector is made up of those private industries and government departments that either depend on the ocean as a resource, or use it as a medium of movement, operation, or innovation. For the purpose of this study, the term 'ocean' is defined broadly to include the coastal zone and to encompass estuarine, inshore, nearshore and offshore waters. The terms 'ocean' and 'marine' were used interchangeably in this report.

The economic importance of the ocean sector can be shown in several ways. These include:

- its direct and indirect contribution to Gross Domestic Product (GDP), the measure of the economic value of a society's production of goods and services during the year.
- how many people the ocean sector employs; because of the seasonality of many ocean sector jobs, a full time equivalent (FTE) is calculated.
- how much these people take home in wages and salaries.

In calculating the net impact of these ocean sector contributions in Prince Edward Island, an average of the three years 1997, 1998 and 1999 was used; these were the most recent years for which complete data were available. Note that in the case of public sector agencies the period equates to fiscal years 1997/1998 to 1999/2000.

Table ES.1 and Chart ES.1 indicate the direct and total (direct + indirect + induced)[1] impacts of the ocean sector, and are calculated using Canmac's Prince Edward Island Input-Output tables. Table ES.1 and Chart ES.1 incorporate the economic activities that are, to a greater or lesser extent, related to ocean resources. They only include data for ocean-related activities for which data could be readily obtained or estimated; however, it is concluded that these data cover a large majority of relevant activities. The study team has estimated impacts conservatively.

The direct impact of the ocean sector in Prince Edward Island amounted to $247 million, or 10.0% of GDP. The direct GDP contribution of traditional fishing plus aquaculture amounted to 2.7% of PEI's GDP in comparison to the 4.8% direct contribution of the important agriculture and related service industries. Once indirect and induced effects associated with the ocean sector were incorporated, the ocean sector's share of GDP increased to 17.1%, or more than $421 million total GDP impact.

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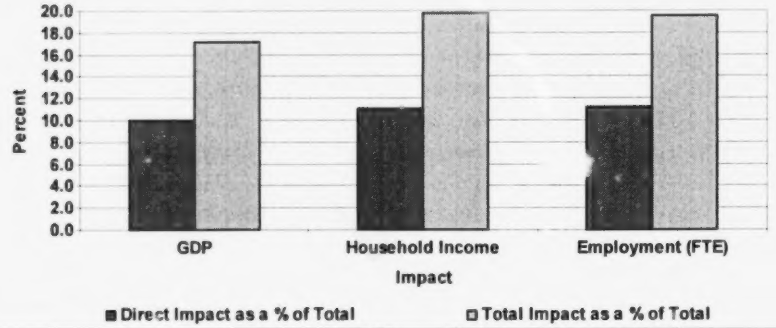
[1] See Appendix H on page 94 – Glossary of Terms.

The ocean sector also accounted for 11.1% of direct household income in Prince Edward Island (almost $169 million), and 19.8% of total household income ($302.4 million). This made it an important contributor to family spending and retail sales, especially in coastal communities.

Table ES.1: The Ocean Sector in PEI: Summary of Economic Impacts

	Direct Impact		Total Impact	
	Impact	% of Total PEI	Impact	% of Total PEI
GDP	$247.2 Million	10.0	$421.4 Million	17.1
Household Income	$168.9 Million	11.1	$302.4 Million	19.8
Employment (FTE)	6,701	11.2	11,722	19.5

Chart ES.1: The Ocean Sector in PEI: Summary of Economic Impacts



In relation to total employment in PEI, the employment impacts of the ocean sector were respectively 11.2% direct impact (6,701 FTE), and 19.5% total impact (11,722 FTE). This means that close to one in five persons employed in Prince Edward Island could trace their employment to economic activities involving the ocean. This proportion rose to a much higher value in coastal communities.

Table ES.2 gives details of the contributions of private industries and government departments to the ocean sector in Prince Edward Island, ranked in descending order of GDP. For the three indicators (GDP, household income, and employment) most of the economic impact (over 95% of the total ocean sector) was from private industries. However, the proportion accounted for by government departments, although small, was important because of their critical management and regulatory roles.

For the purpose of this study, ten private industry groups were identified as ocean-related. In terms of impact, fish processing, traditional fishing, and aquaculture, ranked 1st, 3rd and 5th respectively, accounted for over 60% of the total impact of the ocean sector. These three, together with tourism and transportation (ranked 2nd and 4th overall), comprised the top five industries in terms of ocean-related economic activity. Thus fish processing, tourism, traditional fishing, transportation and aquaculture accounted for 89.9% of the private industry total, and 86.6% of the grand total of all private industries and government departments; 89.4% and 85.4% respectively of household incomes; and 90.4% and 87.1% respectively of employment.

Table ES.2: The Ocean Sector in PEI:
Summary of Total Economic Impacts (Average of 1997, 1998 and 1999)

	Total GDP	Total Household Income	Total Employment (FTE)	Overall Rank by GDP
	$ Million			
Fish Processing	174.6	126.9	5,262	**1**
Ocean-related Tourism	80.3	51.7	2,042	**2**
Traditional Fishing	58.8	58.8	2,173	**3**
Marine Transportation	38.2	13.4	452	**4**
Aquaculture	13.0	7.2	283	**5**
Ports and Harbours	10.5	9.3	319	**6**
Marine Technology Manufacturing	9.5	6.2	208	**7**
Shipbuilding and Boatbuilding	9.1	7.8	259	**8**
Department of Fisheries and Oceans (a)	8.7	7.5	218	**9**
Research and Other Services	8.2	4.3	158	**10**
Marine Construction Services	3.7	3.0	143	**11**
Parks Canada (a)	3.5	2.9	99	**12**
PEI Department of Fisheries, Aquaculture and Environment (a)	1.6	1.5	45	**13**
Tourism PEI (a)	1.5	1.5	56	**14**
Environment Canada (a)	0.1	0.1	4	**15**
Total Private Industry	**405.9**	**288.8**	**11,298**	
Total Government Department (a)	**15.4**	**13.6**	**423**	
Grand Total	**421.4**	**302.4**	**11,722**	

Note (a) Public sector.
Source: Computed by Canmac Economics Ltd

The relative ranking of the traditional fishing and fish processing industries is influenced by the need to eliminate double-counting between industries, *e.g.*, fish processing plants purchase fish from the traditional fishery. If the economic impact of the traditional fishery and the economic impact of the fish processing industry had each been measured in gross terms, the fish would have been counted twice, since each sector would count the fish as part of its respective output. To offset double-counting within the fish-related industries (excluding aquaculture), only the direct impact of traditional fishing was reported in Table ES.2. The indirect and induced impacts of traditional fishing were included with fish processing. This is standard economic practice, *i.e.* to award the indirect and induced impacts to the higher value-added activity, for example, in the case of fishing and fish processing, to the latter. For details, refer to Chapter Three.

The other significant ocean-related private industries, in descending order of total economic impact, were ports, technology, ship and boatbuilding, research, and construction. Although their relative share was small (about 9.7% of the GDP attributable to the ocean sector), they are important because of their significant potential. This is certainly the case for manufacturing technology and research services.

The biggest public sector presence with respect to oceans was the Department of Fisheries and Oceans (DFO), which has a wide-ranging mandate under the Oceans Act to manage ocean-related activities. The lead provincial department was the PEI Department of Fisheries, Aquaculture and Environment. Other government departments contributing directly to the ocean sector were Environment Canada, Parks Canada, and Tourism PEI. The government departments listed in Table ES.2 are those with annual budget expenditures directly related to the ocean sector. Other federal departments/agencies such as Public Works and Government Services Canada, the Atlantic Canada Opportunities Agency, and provincial departments such as Development and Technology, made either indirect (off-island expenditures) or intermittent (on a project basis) contributions to the ocean sector. These contributions are discussed in more detail in Chapter Two.

The ocean sector can also be broken down into those activities that depend on the ocean as a resource, and those that use the ocean as a medium of operation or movement. The quality of the ocean environment is much more important to resource users, which include fish processing, traditional fishing, aquaculture, and tourism. These four private industries combined accounted for 78% of the total economic impact of the ocean sector in terms of GDP ($326.7 million); household incomes of $244.6 million; and employment of 9,760 FTE. This emphasizes the importance of not only managing the marine resources, but also protecting and improving environmental quality in order to sustain the jobs and incomes that depend on them.

Future studies of the ocean sector should move beyond traditional economic accounting exercises to consider the costs and implications of depleted resources, pollution, and environmental degradation on economic growth. They should also consider the important values associated with coastal and ocean resource systems that are not currently traded in organized economic markets and do not have identified prices by which their economic importance can be gauged. These are the core issues of environmental economics which are reviewed in Chapter Four.

Although natural resources are traditionally divided into three categories: renewable (*e.g.*, fish); non-renewable (*e.g.*, fossil fuels); and continuous (*e.g.*, tidal power), a third category, environmental resources and services (*e.g.*, waste sink), facilitates the integration of market and non-market resources into economic analyses. The ocean components of the latter category, currently not marketed, can provide present and future economic value to PEI.

To fully comprehend environmental economics, a systems-oriented representation of the interaction between economy and environment must be adopted. To accommodate this requirement, the Input-Output (I/O) accounts, derived like the GDP estimates from the System of

National Accounts, are extended to include environmental and resource accounts that make possible a better integration of environment and economy. These extended I/O or satellite accounts, for example, a 'natural resource stock account', can be applied to PEI; however, they must be tailored to fit the unique economic and ecological structure of the Province.

The measurement of non-market values is another challenge; transforming information on physical qualities, such as a pristine beach, to economic values in dollar terms requires the application of a variety of technical methodologies.

For Prince Edward Island to maintain and sustain economic progress in the ocean sector will require constant attention to the development of new markets and products, perhaps through the establishment of industrial clusters. In addition, it will require the reconciliation of environment and economics in the management of resources, and for the protection of the environment on which they depend - the ocean.

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Chapter One
Introduction

1.1 Introduction

This report presents estimates of the importance of the ocean sector in the Prince Edward Island economy. The ocean sector is defined as any industry or industrial sector which derives its resources directly from the ocean and/or uses the ocean as a medium of operation, and/or provides its products for use in the ocean environment. The ocean sector also includes government departments which have mandates and responsibilities, wholly or partly, for activities related to the ocean or to ocean resources. The impact of this sector is measured relative to the total provincial economy. It comprises both private industry and government departmental activities involving the waters that border PEI.

Estimating the value of the ocean sector in PEI will contribute to the development of coastal and ocean policy and to the management of coastal and ocean resources. This is the first study in PEI to attempt this estimation. It employs a methodology which was first developed and used in a Nova Scotia[2] study and then applied to New Brunswick[3]. It was recently applied in a Newfoundland and Labrador[4] study and continues to be refined.

The report is divided into five chapters. The first chapter provides the context for the study. Chapter Two describes the assembly of basic data, profiles the ocean sector in more detail (by industry and by government department), and provides the direct value or impact of the sector to PEI. Chapter Three provides estimates of indirect and induced economic impacts of the ocean sector, based on the data reported in Chapter Two. Chapter Four complements the traditional economic analyses in the previous chapters and considers the environmental impact of ocean-related activities with respect to resource depletion, pollution and environmental degradation. Chapter Five draws some conclusions and makes recommendations for future studies.

Appendix A provides a brief analysis of data quality, describes sources or origins of the data and identifies the Standard Industrial Classification Codes. Appendix B contains a brief description of the Input-Output (I/O) model that was used to estimate total impacts. Appendix C presents the impact multipliers used to estimate indirect and induced impacts. Appendix D considers non-market ocean functions. Appendix E describes the transition from a linear throughput model to a systems perspective. Appendix F extends the Input-Output systems with environmental and resource accounts and Appendix G considers the measurement of non-market values. Appendix H provides a Glossary of Terms and Appendix I the Bibliography.

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[2] See Mandale Consulting, Canmac Economics and the North American Policy Group (1998).

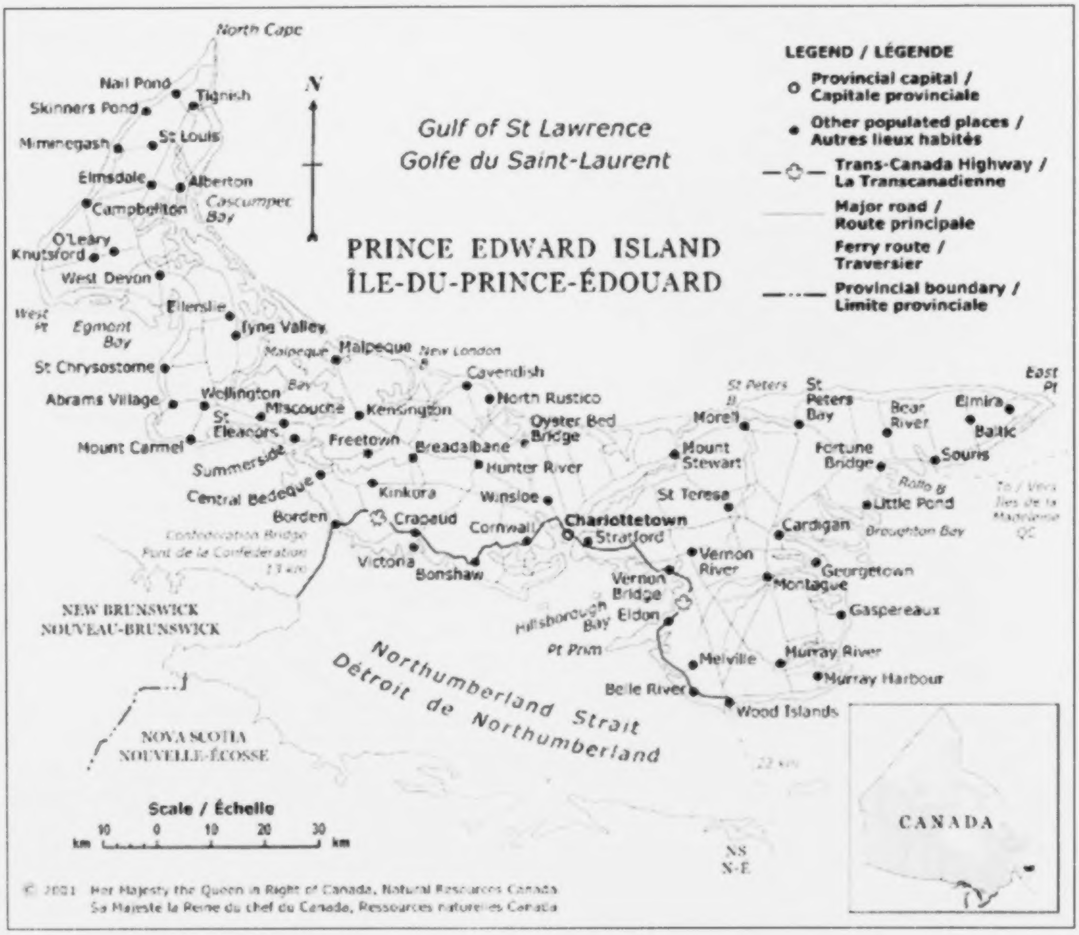
[3] See Mandale Consulting, Canmac Economics and P.Y. Chiasson & Associates (2000).

[4] See Newfoundland and Labrador Department of Finance (2002).

1.2 Background

Prince Edward Island (PEI), with an area of 5,660 km^2 and a coastline of 1,836 km, had an estimated population of 137,639 in 1999, making it the most densely populated province in Canada (24 inhabitants/km^2). PEI, situated in the southern Gulf of St. Lawrence, is bordered on the south by the Northumberland Strait and on the north by the Magdalen Shallows. Located between 62° and 64° west longitude and 46° and 47° north latitude, the Island is now linked to the mainland by the 12.9 km Confederation Bridge, which was opened in June of 1997. The inter-provincial road infrastructure is completed by one seasonal ferry link between Wood Islands and Pictou, Nova Scotia, and another between Souris and the Magdalen Islands (Îles-de-la-Madeleine) of Québec. The provincial capital, Charlottetown, is the Province's dominant economic and administrative centre. Refer to Figure 1.1.

Figure 1.1: Prince Edward Island


North Cape
N
Gulf of St Lawrence
Golfe du Saint-Laurent
PRINCE EDWARD ISLAND
ÎLE-DU-PRINCE-ÉDOUARD
LEGEND / LÉGENDE
Provincial capital / Capitale provinciale
Other populated places / Autres lieux habités
Trans-Canada Highway / La Transcanadienne
Major road / Route principale
Ferry route / Traversier
Provincial boundary / Limite provinciale
Nail Pond
Tignish
Skinners Pond
Miminegash
St Louis
Elmsdale
Alberton
Campbellton
Cascumpec Bay
O'Leary
Knutsford
West Devon
West Pt
Egmont Bay
Ellerslie
Tyne Valley
Malpeque
Malpeque Bay
New London
St Chrysostome
Cavendish
Abrams Village
Wellington
Miscouche
Kensington
North Rustico
St Eleanors
Oyster Bed Bridge
Mount Carmel
Freetown
Breadalbane
Summerside
Hunter River
Central Bedeque
Kinkora
Winsloe
Borden
Crapaud
Cornwall
Charlottetown
Stratford
Confederation Bridge
Pont de la Confédération
13 km
Victoria
Bonshaw
St Peters
St Peters Bay
Morell
Mount Stewart
St Teresa
Vernon River
Vernon Bridge
Eldon
Hillsborough Bay
Pt Prim
Melville
Belle River
Wood Islands
Bear River
Elmira
East Pt
Baltic
Fortune Bridge
Souris
Rollo B
Little Pond
To / Vers Îles de la Madeleine QC
Cardigan
Broughton Bay
Georgetown
Montague
Gaspereaux
Murray River
Murray Harbour
Northumberland Strait
Détroit de Northumberland
22 km
NEW BRUNSWICK
NOUVEAU-BRUNSWICK
NOVA SCOTIA
NOUVELLE-ÉCOSSE
NS
N-É
CANADA
Scale / Échelle
km 10 0 10 20 30 km

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1.3 Defining the Ocean Sector

A broad definition of the ocean sector is adopted for this study. The term 'ocean' is defined to include the coastal zone and encompasses estuarine, inshore, nearshore and offshore waters. Also, the terms 'ocean' and 'marine' are used interchangeably in this report.

As well as being an economic resource, coastal and ocean regions are ecological and social systems. The value of coastal and ocean environments far exceeds that measured in economic or market terms. Distinguishing between '*market*' or '*economic*' and other values can be complex but, for the purpose of this study, it essentially encompasses those products from, or uses of, ocean or ocean-related environments that enter the world of commerce; that is, they can be exchanged for money.

This study further acknowledges the important '*non-market*' values of natural functions of oceans, for example, their contribution to the hydrological cycle or the aesthetics of coastal scenery. Usually these are attributes of natural systems that are commonly regarded as being '*free*', that is no commercial market has yet developed for them. The value of natural systems extends beyond the ability of even sophisticated market mechanisms. It should be noted, however, that commercial markets are constantly evolving for previously unpriced products and services; the development of '*tradable permits*' for use by polluters is an example. Chapter Four considers these non-market functions in detail.

For the purposes of this study, defining the ocean sector involved a broad division between those activities that use the ocean as a resource, and those that use it as a medium of movement, operation, or innovation. The first division includes the commercial fishery, aquaculture, and recreation and tourism. The principal characteristic that sets these resource-dependent industries apart is that they are sensitive to deterioration in ocean-related environmental quality. The industries which operate in the ocean milieu, such as marine transportation, are essentially insensitive to this issue.

The ocean sector includes activities that have become important components of the PEI economy, for example the regulation and management of fisheries and the environment. Thus ocean-related activities may reside in private industry or government departments, and can encompass both goods production and services. 'Private Industry' is defined in terms of commercial operations which are carried out to make a profit, or at least to cover the cost of operation.

Although the intent of this study was to include as many relevant activities as possible, lack of data for some activities precluded their use in the analyses. For this reason, the estimates of the economic impact should be considered to be conservative. Further, the study team purposely chose to err on the side of caution in estimating the results, to avoid overstating the impact of the ocean sector on the economy of Prince Edward Island. Consequently, final figures are easier to defend; this was the approach adopted in the studies for both Nova Scotia[5] and New Brunswick[6] Where there is error or omission in this report, its correction would usually increase the relative importance of the ocean sector in the provincial economy.

1.4 Methodology Overview

The two basic steps that form the traditional GDP component of the study are data collection and impact analysis.

Data Collection: This critical step assembled data for each industry and government department. The data include economic output (sales), employment, and payroll (household income). Sources for this data were occasionally identified with ease, but more often required considerable search. In some cases, published sources were easily accessible for most of the required variables. However, some data were extrapolated and, in other cases, data were obtained by special request.

For this study, data were collected for three years (1997, 1998 and 1999 or 1997/1998 to 1999/2000 in the case of public sector agencies) and then averaged for analysis; these are the most recent years for which data were available. This procedure avoided the problem of a single abnormal year and improved the reliability of the final estimates. Data for all three years were not always available for some of the private industries; the exceptions are noted. The data collection phase of the methodology resulted in a set of gross data for each industry and department identified in Chapter Two.

Impact Analysis: Gross data as assembled can be corrected to give the first important set of measurements - the direct impact. The correction involves 'netting out' any double counting in the gross data. This recognizes the fact that impact estimation is an economic accounting exercise. The value of fish bought from fishermen for processing in a fish plant, for example, cannot appear more than once in the exercise; it is always included in the higher value-added activity, in this case, the output of the fish plant. However, if fishermen sold their fish to a plant or final consumer off-island, the fish become an export from the Province, and the value-added is 'captured' by the fishermen rather than the local plant.

Input-Output analysis extends the direct impact to capture so-called indirect and induced effects. Indirect effects are those involving the purchase of inputs by an industry or department to assist it in its own operations. Induced effects are those that accumulate as incomes earned in an industry or department and are spent and re-spent throughout an economy. I/O models have been used to calculate these wider economic impacts since the 1930s. It is based on the presumption of interdependence in an economic system, *i.e.* each activity in the system depends to varying degrees on every other activity, either to supply its inputs or to purchase its outputs. Adding direct, indirect, and induced impacts together gives the total impact of an activity or collection of activities.

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[5] See Mandale Consulting, Canmac Economics and the North American Policy Group (1998).

[6] See Mandale Consulting, Canmac Economics and P.Y. Chiasson & Associates (2000).

The impact analysis will give three key pieces of data - output (or Gross Domestic Product), household income (based on data collected for payroll by industry), and employment.

1.5 Basic Structure of the Prince Edward Island Economy

The most commonly used measure of an economy in Canada is Gross Domestic Product (GDP). This is the sum of the market values of the economy's goods and services in their final use. Prince Edward Island's annual GDP in the late 1990s was $2.46 billion (the average of the years 1997, 1998, and 1999). Table 1.1 compares PEI's GDP with that of the other Atlantic Provinces and Canada.

Table 1.1: Provincial GDPs in Atlantic Canada, and Canada's GDP (Average of 1997, 1998 and 1999)

	$ Billion	% of Canada
New Brunswick	$13.64	1.88
Newfoundland and Labrador	$8.90	1.23
Nova Scotia	$17.18	2.37
Prince Edward Island	$2.46	0.34
Canada	$724.99	100.00

Source: Statistics Canada Publication #15-203

As shown in Table 1.1, PEI's economy was the smallest in Atlantic Canada, and accounted for 0.34% of Canada's GDP. There was an approximate 75:25 split between services and goods in the Province. Services encompassed a huge array of enterprises, ranging from retail stores through haircuts, lawyers, transportation, and health care and education. Ocean-related services included shipping, ports, ferries, large parts of tourism, and professional consulting. Goods have physical substance, such as fish products, ships and boats, or navigation instruments.

Although goods production was less than one-quarter of PEI's economy, the importance of this share should not be underestimated; it provided the lion's share of the Province's exports. Exports are vital to PEI, as they represent much larger markets than those contained within Province. To generate reasonable advances in standards of living, the Province must therefore sell outside its borders. To date, these exports have mostly been goods.

The goods-producing industries are important in the context of the present study. The biggest private industries on the Island are goods-producers. They are, or have the potential to be, export industries in the traditional goods-based sense. This is not to say that the Province does not export services; professional service exports are increasing in importance, as is tourism which is an 'export' in the sense that non-residents come to PEI to spend money they earned elsewhere.

To put PEI's economy in context, Table 1.2 lists some other PEI sectors and their contribution to the provincial GDP. The provincial economy still depends quite heavily on resource-based production, particularly agriculture and the fisheries. Also there have been some fundamental changes to the overall structure of the economy in the 1990s; aerospace services and ancillary industries represent a new significant sector. Similarly the information technology sector, particularly telecommunications-based, *e.g.*, call centres, has emerged as a new source of jobs and incomes.

Table 1.2: Selected Components of PEI's GDP - 1999

	Proportion of GDP (%)
Agriculture	4.8
Fishing and Trapping	1.7
Manufacturing	10.8
Food Processing	6.0
Transportation Equipment	1.8
Services	74.5
Wholesale/Retail Trade	11.9
Finance, Insurance and Real Estate	17.6
Professional Services	2.1
Communications and Utilities	6.4
Public Administration	11.9

Source: Statistics Canada Publication #15-203

1.6 Assessing the Importance of the Ocean Sector: The Experience of Canada and Other Countries

Eight estimates, including this study, of the importance of the ocean sector to national and provincial economies are of comparative interest (see Table 1.3).

The US estimate differs from the others not only because of its age, but also because of its method of calculation. It employed a national accounts approach to divide the economy into an ocean sector and a non-ocean sector, broadly based along geographic rather than industry lines. The 2.6% of the US economy represented by ocean industries (about US$30.6 billion in 1972) matched the aggregate size of agriculture, mining, transportation, and communications in 1972.

The British, Australian and Canadian estimates have been calculated using methods that broadly correspond to those employed in the current study, but are confined to *direct* impacts only, and cover a rather different array of activities. Measuring direct impacts is an important first step in any assessment of the ocean sector, but fails to capture the indirect and induced ('spin-off') impacts that come with the spending and re-spending of ocean sector incomes and profits throughout the larger economy.

The British ocean sector had a net direct impact of 4.8% of the national economy in 1994-95, or £28.7 billion (Cdn$58.2 billion). The 17 activities considered include familiar ones, like the fishery, tourism, shipbuilding, ports, and ocean-related crossings (ferries and toll bridges), plus others such as oil and gas, defence, telecommunications (underwater cables), and aggregates (seabed mining) that are less familiar in the context of Prince Edward Island.

Table 1.3: Estimates of the Value of the Ocean Sector in Selected Economies

Jurisdiction	Benchmark Year	Estimate (% of Economy)
United States [7]	1972	2.6% (GNP)
United Kingdom [8]	1994-95 (mostly)	4.8% (GDP)
Australia [9]	1994 (mostly)	8.0% (GDP)
Canada [10]	1988	1.6% (GDP)
	1996	1.4% (GDP)
Nova Scotia [11]	1994	9.6% (Direct GDP) 17.5% (Total GDP)
New Brunswick [12]	1995-1997	4.3% (Direct GDP) 7.2% (Total GDP)
Newfoundland and Labrador [13]	1997-1999	14.1% (Direct GDP) 26.5% (Total GDP)
Prince Edward Island [14]	1997-1999	10% (Direct GDP) 17.1% (Total GDP)

In 1994, the ocean sector accounted for 8% of the Australian economy, amounting to A$30 billion (about the same in Canadian dollars). The activities conform quite closely to the private industries identified for PEI. The Australian study also noted that the ocean sector grew by about 8% a year in real terms (inflation-adjusted) between 1987 and 1994, well over the rate for the total economy, and accounted for 7.7% of total exports from Australia in 1994.

The Canadian study estimated the direct impact of the ocean sector as 1.6% of GDP in 1988 and falling to 1.4% in 1996. The study also provided some regional data. In Atlantic Canada, the contribution was 10.2% of GDP in 1996. In the Pacific region, the contribution was 3.9% of GDP.

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[7] See Pontecorvo *et. al.* (1980).
[8] See Pugh and Skinner (1996).
[9] See Australian Marine Industries and Science Council (1997).
[10] See Department of Fisheries and Oceans (1998).
[11] See Mandale Consulting, Canmac Economics and the North American Policy Group (1998).
[12] See Mandale Consulting, Canmac Economics and P.Y. Chiasson & Associates (2000).
[13] See Newfoundland and Labrador Department of Finance (2002).
[14] This study.

Alone among these estimates, the Nova Scotia and New Brunswick studies estimated both direct and total impacts, and also included estimates for employment and household income. In terms of GDP, the ocean sector contributed about 10% of direct GDP in Nova Scotia, and 17.5% of total GDP. Employment and household income estimates were roughly the same in direct terms, but increased to almost one-quarter of all jobs and incomes in terms of total impact. The methodology used for the Nova Scotia study was applied and improved upon in the study for New Brunswick. The New Brunswick study provided estimates of 4.3% for direct GDP and 7.2% for total GDP. The Newfoundland and Labrador study estimated the direct GDP to be 14.1% and the total GDP 26.5%.

Chapter Two
The Prince Edward Island Ocean Sector: Direct Impacts of Private Industries and Government Departments

This chapter details the direct value or impact of the ocean sector to the economy of Prince Edward Island. It first identifies those private industries and government departments that relate more or less directly to the ocean. For each activity, three sets of data are presented: direct output (sales), employment, and payroll. The data were compiled wherever possible for three consecutive years (1997, 1998, and 1999) and an average of these years was utilized for the impact estimates. Where data were available, value of exports was added to the summary tables in this chapter to supplement the brief descriptions of recent trends, and to demonstrate the importance of the ocean sector as an export earner.

In Chapter One PEI's ocean-related private industries were broadly defined as those that either use the ocean as a resource, or as a medium of operation. Government is also actively involved. It can pursue a developmental role and promote job creation in private industries such as aquaculture and traditional fishing, but it also has important regulatory, management, safety (rescue), and infrastructure responsibilities as well. These roles are summarized in this chapter.

There are fifteen relevant ocean-related industries or departments, ten of which are within the private sector and five are government departments:

Private Industries:
- Traditional fishing
- Aquaculture
- Fish processing
- Shipbuilding and boatbuilding
- Marine technology manufacturing
- Marine transportation
- Marine construction services
- Ports and harbours
- Ocean-related research and other services
- Ocean-related tourism

Government Departments:
- PEI Department of Fisheries, Aquaculture and Environment
- Tourism PEI
- Department of Fisheries and Oceans
- Environment Canada
- Parks Canada

2.1 Private Industries

There are ten private industries engaged in the ocean sector in PEI. These are evenly split between goods-producers and service providers. Goods-producing industries in general are bigger and therefore tend to be more important in terms of economic impact.

2.1.1 Traditional Fishing

PEI's traditional fishery has been a mainstay of the ocean sector for many years. Crustaceans and molluscs accounted for 90% of the total landed value in 1999. Pelagic and estuarial species accounted for 7% of total landed value. Groundfish and seaplants made up the remainder.

The overall performance of the traditional fishery in PEI has exhibited a modest growth in volume but a strong growth in economic performance. Over the period 1987 to 1999, landings ranged from a high of 71,504 metric tonnes in 1990 to a low of 43,370 metric tonnes in 1993. Over the same period, landed values increased from $68.3 million in 1987 to $131.2 million in 1999 – an increase of 92% (see Charts 2.1, 2.2 and 2.3).

The high landed values in PEI are a direct consequence of the traditional fishery being dominated by lobster catches. The heavy reliance on the lobster fishery has made the PEI fishery more seasonal than its sister provinces in Atlantic Canada. This seasonality is mainly the result of winter ice conditions in the Gulf of St. Lawrence. Unlike PEI, the provinces of Nova Scotia and New Brunswick are not totally ice-bound in winter; hence their traditional fisheries are somewhat less seasonal. The harvest of non-traditional species in recent years has been a source of diversification for the PEI fishery.

Chart 2.1: PEI Traditional Fishing: Landings 1987-1999

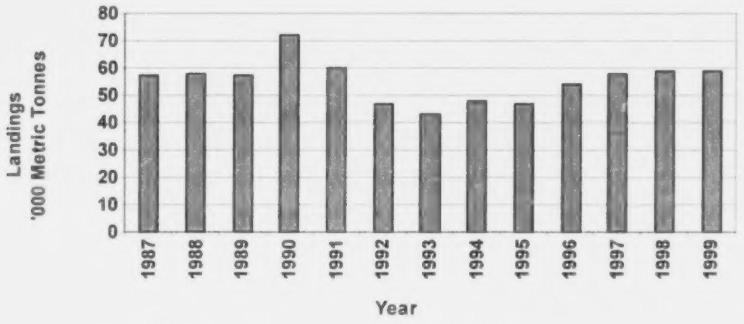


Chart 2.2: PEI Traditional Fishing:
Landed Value 1987-1999

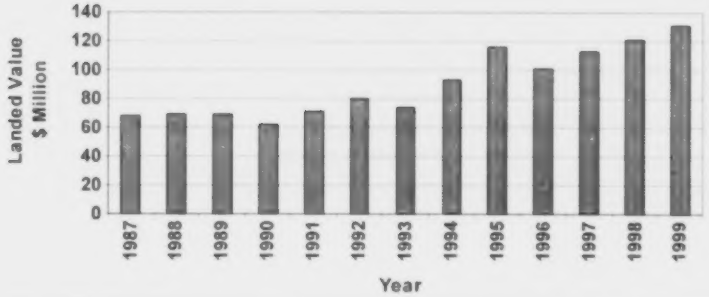
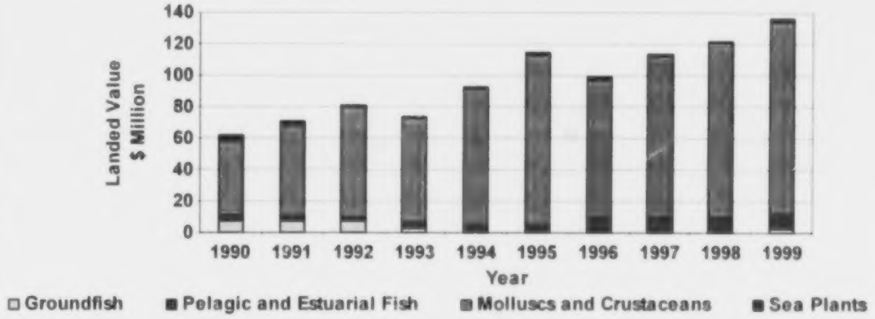


Chart 2.3: PEI Traditional Fishing:
Landed Value by Group 1990-1999



Source for Charts 2.1, 2.2 and 2.3: DFO website, Statistics; Canmac Economics Ltd

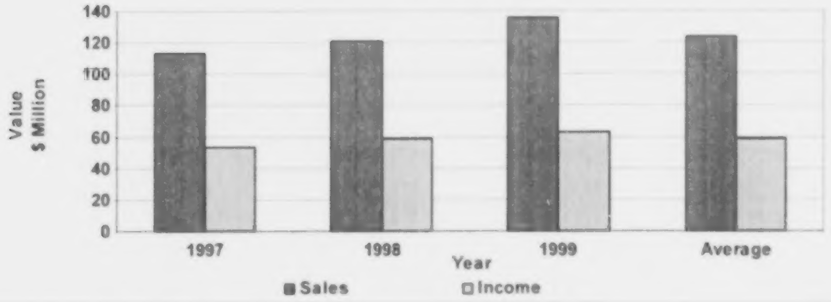
Table 2.1 and Chart 2.4 present basic data for the traditional fishery. The industry had average sales of $123.3 million from 1997 to 1999, employed 2,173 persons (full-time equivalent) and provided income of $58.8 million.

**Table 2.1: PEI Traditional Fishing:
Key Economic Indicators**

	1997	1998	1999	Average
Sales ($ 000)	112,667	121,115	136,262	123,348
Employment (FTE)	2,139	2,181	2,198	2,173
Income ($ 000)	54,497	58,583	63,445	58,842

Sources: DFO Statistical Review, various years.
Revenue Canada Taxation Statistics, various years.

**Chart 2.4: PEI Traditional Fishing:
Key Economic Indicators 1997-1999**



Figures for the year 1999 from the PEI Department of Fisheries, Aquaculture and Environment indicated that the total number of commercial fishermen was 4,737. The majority were licensed as lobster fishermen (1,274), mackerel fishermen (1,276), herring fishermen (868) and groundfish fishermen (862). Many fishermen held more than one licence. The total number of 4,737 represented 2,173 full-time equivalent jobs (Table 2.1) in the traditional fishery which understated the importance of the fishery as a job creator. The total number of fishermen (4,737) in relation to full-time equivalents (2,173) equates to a 2.2:1 conversion ratio.

2.1.2 Aquaculture

The relatively static level of landings in the traditional fishery has been a stimulus to aquaculture production on the Island. Indeed, the aquaculture sector exhibited significant growth over the 1987 to 1999 period. In 1987, aquaculture production was worth a modest $3.9 million; by 1999, production had increased almost six fold to $22.7 million.

The major species in aquaculture were mussels at 74% of total landed value in 1999, oysters at 22%, and finfish at 4%. From 1987 to 1999, mussels also exhibited the greatest growth in landed value, increasing from $1.7 million in 1987 to $16.8 million in 1999. Over the same period, the value of finfish increased from $47,000 to $786,000 while oysters increased from $2.2 million to $5.1 million (Charts 2.5, 2.6 and 2.7).

Table 2.2 and Chart 2.8 present basic data for the PEI aquaculture sector. For the 1997 to 1999 period, aquaculture sales averaged $19.8 million, with an average employment of 191 (full-time equivalent) and an average payroll of $4.8 million.

Chart 2.5: PEI Aquaculture:
Production 1987-1999

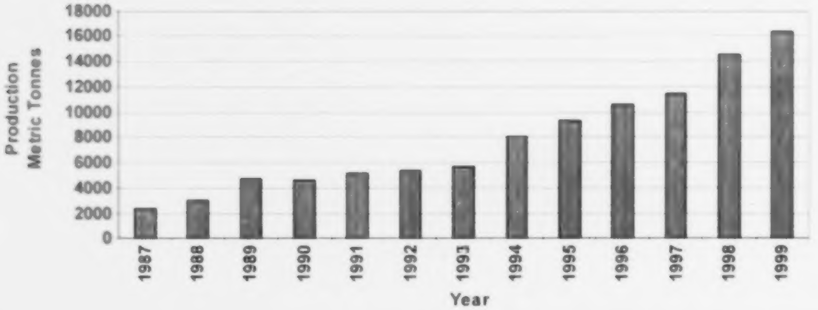


Chart 2.6: PEI Aquaculture:
Landed Value 1987-1999*

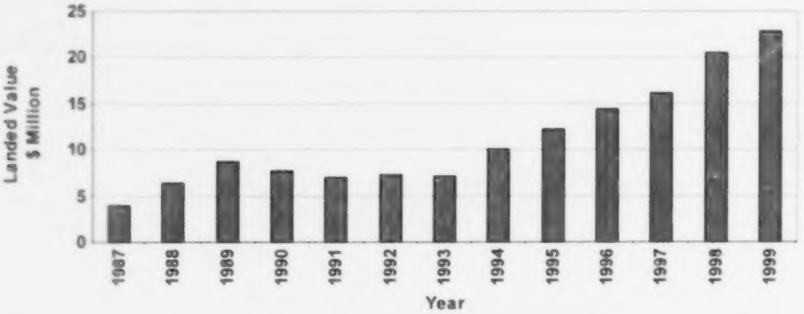
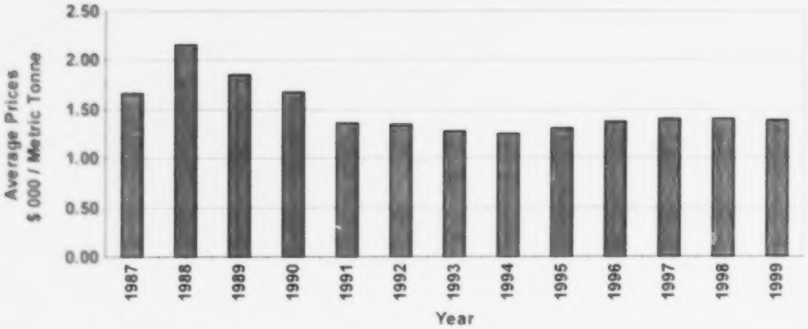


Chart 2.7: PEI Aquaculture:
Average Prices 1987-1999

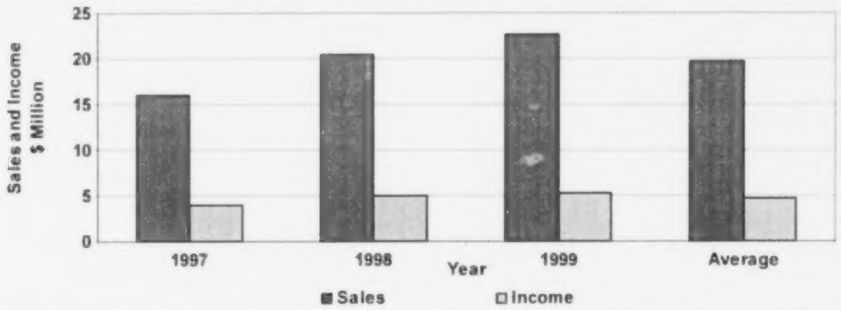


Source for Charts 2.5 and 2.6: DFO website and Statistics Canada; Chart 2.7: Canmac Economics Ltd
* In Chart 2.6, 1987-89 data are not directly comparable to 1990-99 due to changes in accounting method.

Table 2.2: PEI Aquaculture: Key Economic Indicators				
	1997	**1998**	**1999**	**Average**
Sales ($ 000)	16,128	20,439	22,706	19,758
Exports ($ 000)	15,322	19,417	21,571	18,770
Employment (FTE)	162	199	212	191
Income ($ 000)	4,000	5,000	5,300	4,767

Sources: PEI Department of Fisheries, Aquaculture and Environment; DFO; Statistics Canada Publication #21-603 and #23-603; Industry officials; Canmac Economics Ltd

Chart 2.8: PEI Aquaculture:
Key Economic Indicators 1997-1999



As with the traditional fishery, aquaculture full-time equivalent employment understated the importance of the industry as a job creator. Figures for 1999 from the PEI Department of Fisheries, Aquaculture and Environment indicated that approximately 1,500 persons were employed in the aquaculture sector seasonally or part-time.

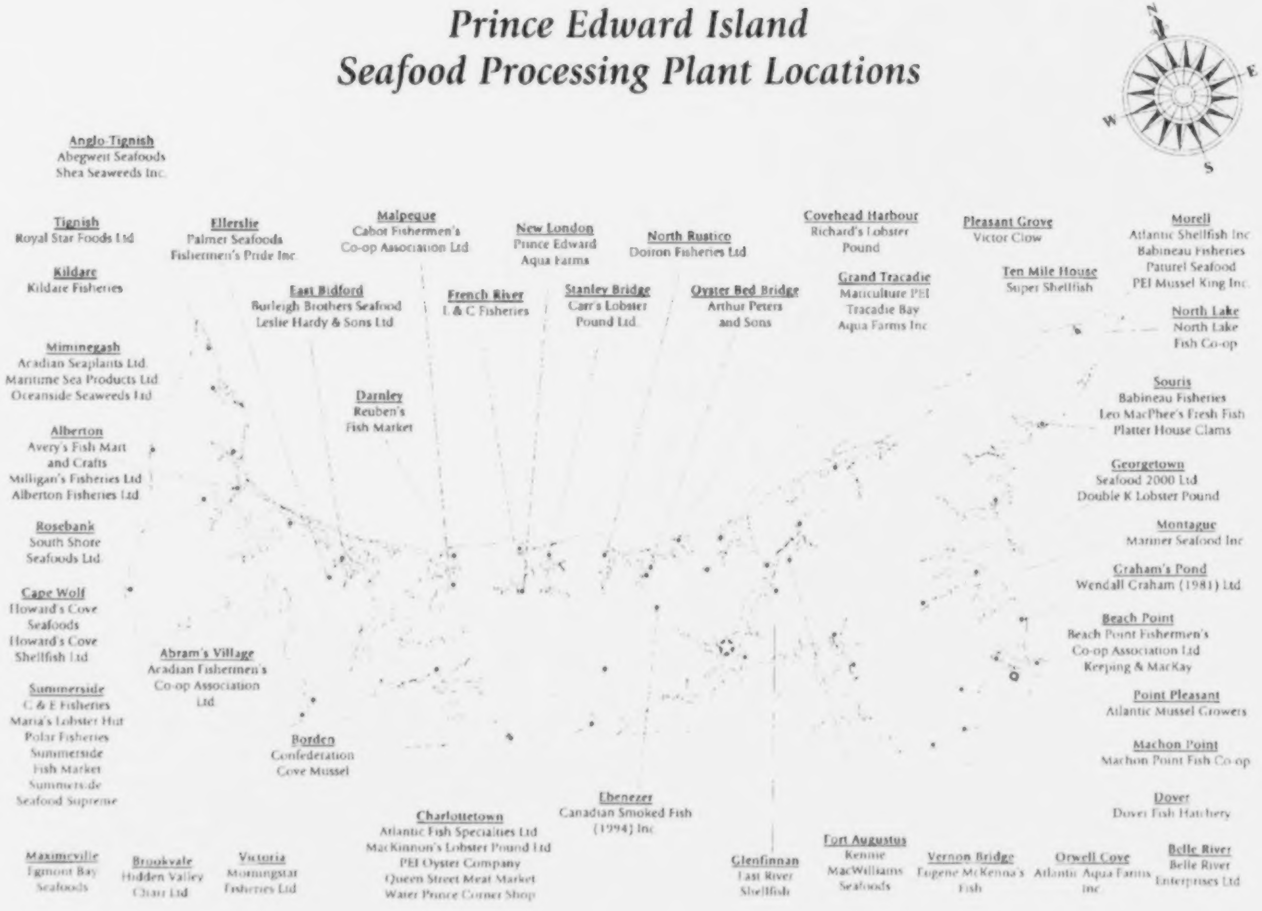
2.1.3 Fish Processing

The fish processing industry, as with many other Island industries, was a significant exporter with approximately 90% of its output being sold outside the Province. Fish products represented approximately 20% of PEI total manufacturing shipments (both on-island and off-island) in 1998. This proportion has remained fairly stable over the last decade ranging from a high of 28% in 1991 to a low of 19% in 1996. Early estimates for 1999 indicated a return to the 28% level.

According to the 2001 PEI Department of Fishery, Aquaculture and Environment *Seafood Product Directory*, the Province has over 60 seafood processing plants located throughout the coastal communities of the Island (see Figure 2.1 on the next page).

Figure 2.1

Prince Edward Island
Seafood Processing Plant Locations


N
E
S
W
Anglo-Tignish
Abegweit Seafoods
Shea Seaweeds Inc
Tignish
Royal Star Foods Ltd
Kildare
Kildare Fisheries
Miminegash
Acadian Seaplants Ltd
Maritime Sea Products Ltd
Oceanside Seaweeds Ltd
Alberton
Avery's Fish Mart and Crafts
Milligan's Fisheries Ltd
Alberton Fisheries Ltd
Rosebank
South Shore Seafoods Ltd
Cape Wolf
Howard's Cove Seafoods
Howard's Cove Shellfish Ltd
Summerside
C & E Fisheries
Maria's Lobster Hut
Polar Fisheries
Summerside Fish Market
Summerside Seafood Supreme
Ellerslie
Palmer Seafoods
Fishermen's Pride Inc
Malpeque
Cabot Fishermen's Co-op Association Ltd
East Bidford
Burleigh Brothers Seafood
Leslie Hardy & Sons Ltd
Darnley
Reuben's Fish Market
French River
L & C Fisheries
New London
Prince Edward Aqua Farms
Stanley Bridge
Carr's Lobster Pound Ltd
North Rustico
Doiron Fisheries Ltd
Oyster Bed Bridge
Arthur Peters and Sons
Covehead Harbour
Richard's Lobster Pound
Grand Tracadie
Mariculture PEI
Tracadie Bay Aqua Farms Inc
Pleasant Grove
Victor Clow
Ten Mile House
Super Shellfish
Morell
Atlantic Shellfish Inc
Babineau Fisheries
Paturel Seafood
PEI Mussel King Inc
North Lake
North Lake Fish Co-op
Souris
Babineau Fisheries
Leo MacPhee's Fresh Fish
Platter House Clams
Georgetown
Seafood 2000 Ltd
Double K Lobster Pound
Montague
Mariner Seafood Inc
Graham's Pond
Wendall Graham (1981) Ltd
Beach Point
Beach Point Fishermen's Co-op Association Ltd
Keeping & MacKay
Point Pleasant
Atlantic Mussel Growers
Machon Point
Machon Point Fish Co-op
Dover
Dover Fish Hatchery
Abram's Village
Acadian Fishermen's Co-op Association Ltd
Borden
Confederation Cove Mussel
Maximeville
Egmont Bay Seafoods
Brookvale
Hidden Valley Charr Ltd
Victoria
Morningstar Fisheries Ltd
Charlottetown
Atlantic Fish Specialties Ltd
MacKinnon's Lobster Pound Ltd
PEI Oyster Company
Queen Street Meat Market
Water Prince Corner Shop
Ebenezer
Canadian Smoked Fish (1994) Inc
Glenfinnan
East River Shellfish
Fort Augustus
Kennie MacWilliams Seafoods
Vernon Bridge
Eugene McKenna's Fish
Orwell Cove
Atlantic Aqua Farms Inc
Belle River
Belle River Enterprises Ltd

The type of fish processing 'echoes' the traditional fishery with shellfish, mainly lobster, being the dominant species. Charts 2.9 and 2.10 show the significant and growing contribution of the fish processing sector to PEI's economy over many years. The value of shipments increased from $14.5 million in 1971 to $189.6 million in 1998 and was estimated to be $317.3 million in 1999. This large increase was partially due to the increased catch, the amount of on-island processing and the higher price paid for the commodity. However, the fact that the 1999 figure represented a 67% increase in the value of shipments over the previous year raises concerns about the accuracy of the data.

Employment and income in the fish processing sector also increased significantly over the years. By 1998 the sector was employing 1,285 persons (full-time equivalent) and contributing $24.6 million of employment income to the economy. Although the 1999 principal statistics are not yet available, it is estimated, based on the value of shipments, that the 1999 employment was 2,150 persons (full-time equivalent), with an income of $41.1 million. Recent statistics by the PEI Department of Fisheries, Aquaculture and Environment indicated that employment can peak at 3,000 persons over the course of the year.

Chart 2.9: PEI Fish Processing: Value of Shipments 1971-1998

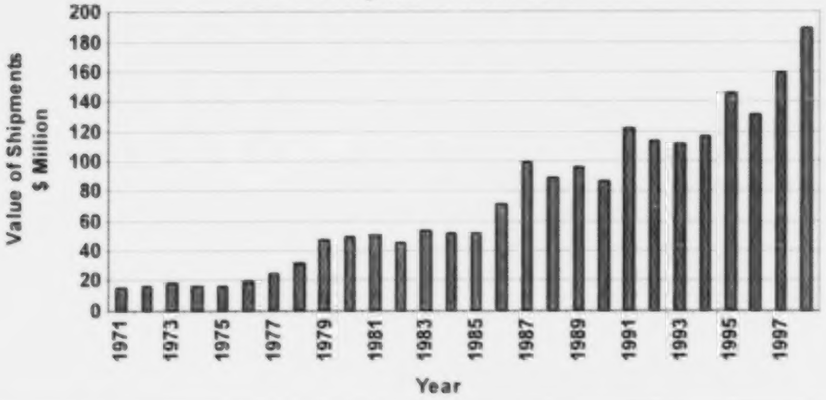
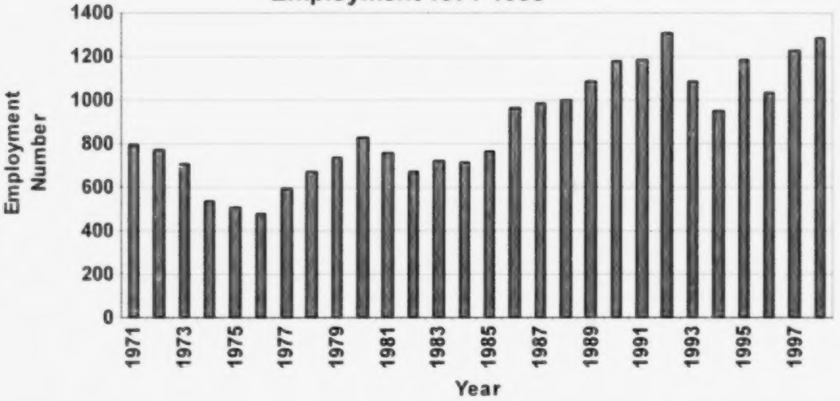


Chart 2.10: PEI Fish Processing: Employment 1971-1998



Source for Charts 2.9 and 2.10: Statistics Canada Publication #31-203

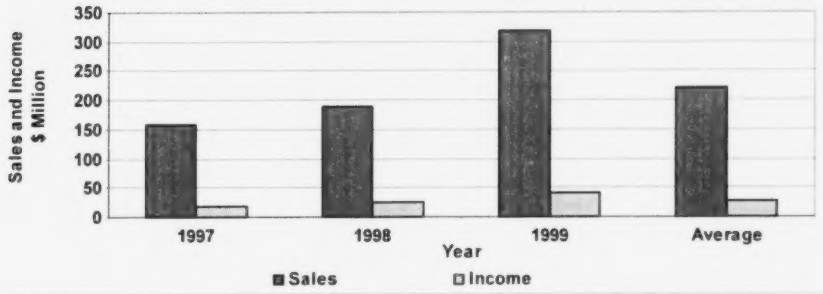
Table 2.3 and Chart 2.11 provide the basic fish processing data for the study period (1997-1999). Average sales were $221.9 million a year. Average employment was 1,554 persons (full-time equivalent), with an aggregate income of $28.4 million. This industry was a significant exporter with approximately 90% of its output being sold outside the Province at a value of $200 million.

Table 2.3: PEI Fish Processing: Key Economic Indicators

	1997	1998	1999	Average
Sales ($ 000)	158,700	189,600	317,300	221,867
Exports ($ 000)	142,830	170,640	285,570	199,680
Employment (FTE)	1,228	1,285	2,150	1,554
Income ($ 000)	19,400	24,600	41,082	28,361

Source: Statistics Canada Publication #31-203; Industry Canada; Canmac Economics Ltd

Chart 2.11: PEI Fish Processing: Key Economic Indicators 1997-1999



2.1.4 Shipbuilding and Boatbuilding [15]

Boatbuilding in PEI has been an activity for as long as the fishing industry and similarly has undergone a number of changes over the years. One of the major changes has been a gradual shift from wooden boats to those constructed of fibreglass; wooden boats are still manufactured but in decreasing numbers. A recent profile of boat manufacturing in PEI produced by the Atlantic Canada Opportunities Agency[16] showed that the Province in 2001 had eleven boat manufacturers; six produced fibreglass boats with an annual production of approximately 70 boats and five produced wooden boats with an annual production of 22 boats.

The boatbuilding industry as with the fishing and fish processing industries is one of the mainstays of rural PEI. Table 2.4 shows that these manufacturers are located throughout PEI with none located in the urban centres of Charlottetown and Summerside.

The shipbuilding and repair industry in Canada, and particularly in eastern Canada, has undergone a major shrinkage over the past number of years. PEI now has one active shipyard, East Isle Shipyard of Georgetown.

As shown in Table 2.5 and Chart 2.12, the combined boat and shipbuilding industry in PEI had average annual sales of $17 million over the study period (1997-1999). During this period the industry had an average employment of 182 persons earning approximately $6 million of aggregate income. It is estimated that 50% of the products were exported off-island to other provinces and internationally.

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[15] In general, the distinction between a boat and ship is weight – up to five tonnes is a boat, above five tonnes is a ship.

[16] See ACOA (2001).

Table 2.4: PEI Boatbuilding: Manufacturers in 2001

Builder	Location	Type F=Fibreglass W=Wooden	Employees	Annual Production (# Boats)
Four Ports Marine Inc	Morell	F	15	14
Provincial Boat and Marine Ltd	Kensington	F	20	15
Hutt's Bros Ltd	Northport	F	14	18
Central Marine Fibreglass Ltd	Cornwall	F	19	12
J&M Boatbuilding	Souris	F	3	4
Hustler Boat Builders	Bloomfield	F	3	7
Cape Egmont Enterprises	Cape Egmont	W	5	15
Malcolm Neil MacKay	Murray Harbour	W	1	1
Doucette's Boat Building	Miminegash	W	3	3
Terry Drake Boat Building	Morell	W	1	2
Gallants (repair only)	North Rustico	W	1	1
Total			**85**	**92**

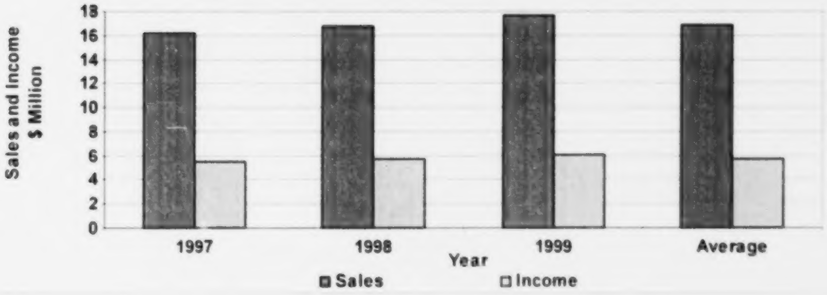
Source: ACOA, 5CAS01-069, A Profile of the PEI Boat Manufacturing Industry, March 2001

Table 2.5: PEI Shipbuilding and Boatbuilding: Key Economic Indicators

	1997	1998	1999	Average
Sales ($ 000)	16,200	16,800	17,741	16,914
Exports ($ 000)	8,100	8,400	8,871	8,457
Employment	174	181	191	182
Income ($ 000)	5,500	5,700	6,135	5,778

Source: Statistics Canada 31-203; Industry Canada; Canmac Economics Ltd

Chart 2.12: PEI Shipbuilding and Boatbuilding: Key Economic Indicators 1997-1999



2.1.5 Marine Technology Manufacturing

Marine technology manufacturing is a significant and growing sector of the PEI economy as can be seen by its growth between 1997 and 1999 (refer to Table 2.6 and Chart 2.13). This sector is concentrated in aquaculture supply and the manufacture of fish processing equipment, although other areas of activity exist such as supplying the shipping and shipbuilding/repair industry. The majority of the manufacturers are located in the Charlottetown area. An interesting point is the level of exports for these industries which, on average, exported 95% of their production; many firms exported 100% of their production.

From the data obtained from personal interviews and telephone surveys of these manufacturers it is apparent that this is a rapidly expanding ocean-related sector. Sales (shipments) rose by 46% between 1997 and 1999 with employment and income showing growth in the 20% range over the same period of time.

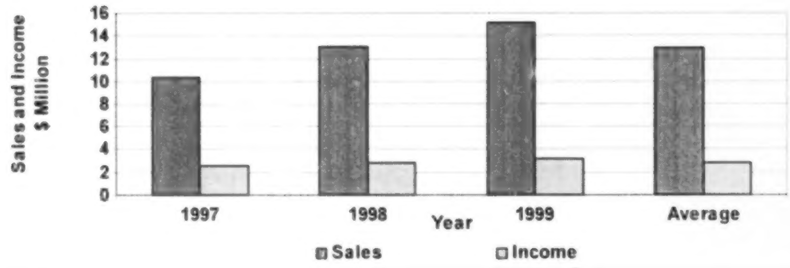
It is estimated that on average (1997-1999) marine technology manufacturing had annual sales of nearly $13 million, of which $12 million was exported. Approximately eighty (80) persons were employed on a full-time basis contributing almost $3 million of aggregate income into the provincial economy.

Table 2.6: PEI Marine Technology Manufacturing: Key Economic Indicators

	1997	1998	1999	Average
Sales ($ 000)	10,425	13,015	15,230	12,890
Exports ($ 000)	9,834	12,244	14,457	12,178
Employment	74	84	88	82
Income ($ 000)	2,585	2,765	3,151	2,834

Source: Personal interviews/survey of industry participants; Canmac Economics Ltd

Chart 2.13: PEI Marine Technology Manufacturing: Key Economic Indicators 1997-1999



2.1.6 Marine Transportation

Marine transportation in PEI is dominated by two 'players', namely the Confederation Bridge operated by Strait Crossings Inc and the Pictou (Nova Scotia) to Wood Islands (PEI) ferry service operated by Northumberland Ferries Ltd. The only other ferry service operates between Souris, PEI and the Magdalen Islands, Québec. This ferry service has been operating for over 25 years and is provided by the CTMA Group of Alma, Québec.

Northumberland Ferries Ltd has its head office located in Charlottetown. In recent years ferry service to the Island has undergone a dramatic change with the building and opening of the Confederation Bridge in June 1997. Much of the impact of this change was absorbed by Northumberland Ferries in 1996 in anticipation of the bridge opening. In 1996 it converted its fleet from four small ships to two large ships, adjusted its workforce accordingly and completed a transportation subsidy agreement with Transport Canada.

The CTMA group has little direct impact on the economy of PEI. Sales are generated in the province of Québec with only the Souris terminal operation and local employment contributing directly to the PEI economy.

Strait Crossing Inc operates the Confederation Bridge that links PEI to the rest of Canada. The Confederation Bridge was completed in June 1997 at a construction cost estimated at $800 million. Operations, on an annual basis, employ approximately 50 persons or 40 on a full-time equivalent basis. The only actual data available for the Confederation Bridge were the annual employment numbers. Data with respect to annual operations and maintenance (O&M), sales and wagebill are considered to be confidential by Strait Crossings Inc. From data available and using a conservative extrapolation, the annual O&M was estimated to be $3.5 million, including $1.8 million in wages and benefits

Sales, employment and income for marine transportation are outlined for the study period in Table 2.7 and Chart 2.14. Annual sales were in the $65 million range with employment of approximately 130 persons on a full-time equivalent basis who contributed an estimated $5 million of aggregate income to the provincial economy.

Table 2.7: PEI Marine Transportation: Key Economic Indicators

	1997	1998	1999	Average
Sales ($ 000)	43,640	75,239	77,248	65,376
Employment	126	134	139	133
Income ($ 000)	4,513	5,030	5,366	4,970

Source: Personal interviews/surveys of industry participants; Canmac Economics Ltd

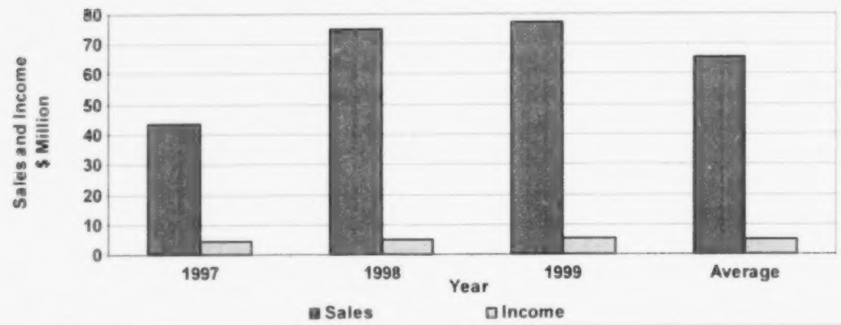


Chart 2.14: PEI Marine Transportation:
Key Economic Indicators 1997-1999

2.1.7 Marine Construction Services

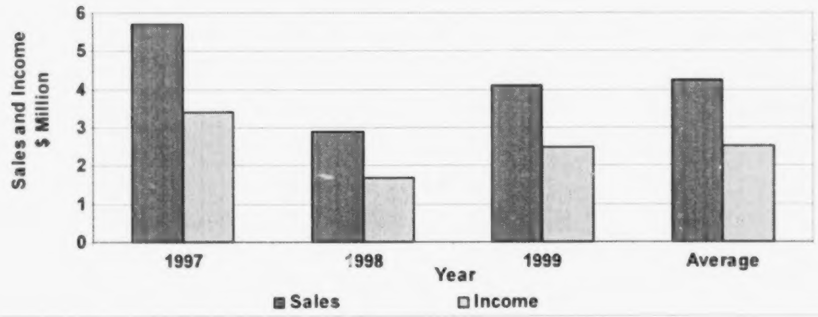
Marine construction is the building, maintenance and repair of docks, wharves, breakwaters and other marine infrastructure necessary for any boat-based enterprise or activity. It is mainly paid for by governments, but the work is generally undertaken by private companies under contracts administered by Public Works and Government Services Canada. The value of construction can be highly variable from year to year, because of the weather and fiscal considerations. Key data are provided in Table 2.8 and Chart 2.15 for 1997 to 1999. The averages for these three years were $4.2 million in sales, employment of 125 persons with an aggregate annual income of $2.5 million.

Table 2.8: PEI Marine Construction Services:
Key Economic Indicators

	1997	1998	1999	Average
Sales ($ 000)	5,700	2,900	4,100	4,233
Employment	138	70	166	125
Income ($ 000)	3,420	1,740	2,460	2,540

Source: Statistics Canada Publication # 61-233; Canmac Economics Ltd

Chart 2.15: PEI Marine Construction Services: Key Economic Indicators 1997-1999



2.1.8 Ports and Harbours

The coastline of Prince Edward Island is dotted with numerous ports and harbours. In terms of economic activity these ports and harbours are dominated by the four major shipping ports of Charlottetown, Georgetown, Souris and Summerside.

Charlottetown, a deepwater commercial harbour, is the most active port in PEI. The port is utilized primarily by the agriculture industry (potatoes), for fuel oil bulk imports to meet the Island's domestic and industrial needs, and for secondary commodity imports such as aggregate (gravel), and the growing cruise ship market.

Summerside, on PEI's south shore, is the second most active deepwater commercial harbour. As with Charlottetown, Summerside is utilized primarily by the agriculture industry (the export of potatoes to the international market and the importation of fertilizer). The port is also used to import aggregate.

The port of Georgetown is a deepwater harbour situated on the southeast coast of PEI. It is primarily used by the construction industry for the off-loading of liquid asphalt and aggregate, by the forestry industry for the export of pulpwood, by the aquaculture industry as a key landing and embarkation depot for area mussel growers, and by East Isle Shipyard for the construction and repair of ships.

The fourth and most diverse harbour is located in Souris. The fishing activity, ferry service and commercial shipping make the port a focal point of economic activity at the eastern end of the Island.

Table 2.9 shows the recent total tonnage handled by the four main Island ports and the relative share of each port.

**Table 2.9: PEI Ports:
Total Tonnage in Metric Tonnes**

Ports	1996	1997	1998	Relative Share of Total Tonnage
Charlottetown	483,993	564,611	664,974	60%
Summerside	255,536	207,130	190,300	23%
Georgetown	140,110	122,954	113,289	13%
Souris	75,607	27,263	13,915	4%
Total	**955,246**	**921,958**	**982,478**	**100%**

Source: Assessment of Future Options and Business Plan for PEI Marine Ports, PEI Ports Study Group, July 1999

According to a 1999 study[17], the four ports combined contributed over $300 million per year to the PEI economy through the handling of $267 million in commodities, $6 million in landed value of live fish, $14 million in tourism expenditures (ferry and cruise ships) and $14 million in port employment and operations. Table 2.10 and Chart 2.16 show the total cargo handled in PEI and at the two largest shipping ports of Charlottetown and Summerside. Between 1986 and 1998, these two ports accounted for between 85% and 90% of all cargo handled in PEI.

**Table 2.10: PEI Total Cargo Handled in Metric Tonnes:
Domestic and International 1986-1998**

Year	PEI	Charlottetown	Summerside
1986	608,192	416,151	128,854
1987	637,598	436,446	134,915
1988	715,562	449,785	124,074
1989	781,565	542,001	142,705
1990	721,026	508,532	136,591
1991	827,304	548,022	143,628
1992	973,718	670,111	192,283
1993	999,107	700,411	214,603
1994	898,211	647,728	115,488
1995	949,813	654,350	203,428
1996	873,841	593,217	189,890
1997	757,605	554,948	105,810
1998	875,669	633,967	148,237

Source: Statistics Canada Publication # 54-205

There are many other ports and harbours along PEI's coast. DFO's Small Craft Harbours website shows 47 fishing (small craft) harbours, 43 of which are now controlled by local harbour authorities. These ports are important as fishing ports and recreational boat harbours.

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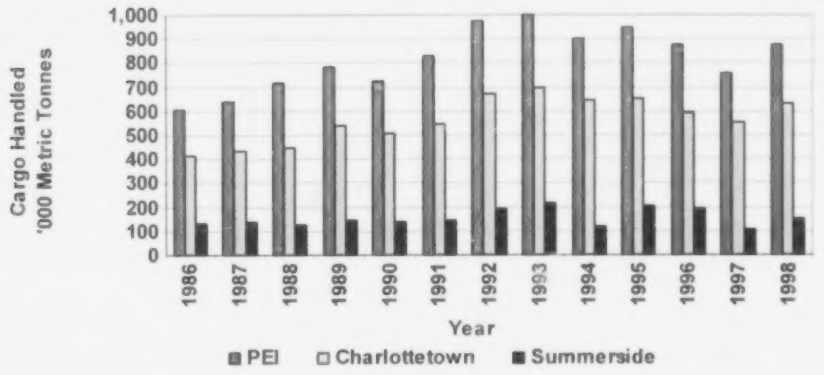
[17] See Prince Edward Island Ports Study Group (1999).

Chart 2.16: PEI Total Cargo Handled:
Domestic and International 1986-1998



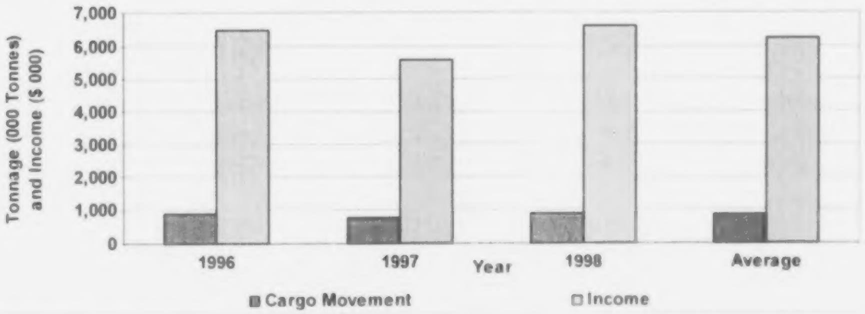
The basic data for PEI ports and harbours are outlined in Table 2.11 and Chart 2.17 for 1996 to 1998. The value of output was not available. Therefore the average movement of cargo through the ports was used as a proxy: 835,705 tonnes were moved employing approximately 200 persons with an aggregate income of over $6 million. The different tonnages indicated for Charlottetown and Summerside in Tables 2.9 and 2.10 are due to the different sources of information.

Table 2.11: PEI Ports:
Key Economic Indicators

Year	1996	1997	1998	Average
Cargo Movement (000 Tonnes)	873.8	757.6	875.7	835.7
Employment	217	180	216	204
Income ($ Million)	6.5	5.6	6.6	6.2

Source: Statistics Canada Publication # 54-205; PEI Ports Study Group; Transport Canada; Canmac Economics Ltd

Chart 2.17: PEI Total Cargo Handled:
Domestic and International 1996-1998



2.1.9 Ocean-related Research and Other Services

Institutions associated with ocean-related research and other services provide an important and growing source of innovation for PEI. The best known of these is the Atlantic Veterinary College (AVC) located in Charlottetown on the campus of the University of Prince Edward Island (UPEI). AVC is the only veterinary college in Atlantic Canada and is one of four in Canada. AVC focuses on three areas: teaching, research, and the science of both aquatic and land-based animals.

AVC activities which contributed export revenue to the Province include tuition fees from out-of-province students, national and international research sales and service income, and funding from the other three Atlantic Provinces. In total these activities contributed $7.4 million in 1999-2000[18].

The key commercial entity of AVC is AVC Inc, a private for-profit company considered to be the corporate arm of UPEI.

This study focused on the ocean-related activities of AVC. In total, AVC had capital and operating expenditures of about $24 million per year with an estimated 318 employees (full-time equivalent) who were employed by the college and AVC Inc[19].

The Atlantic Fish Health (AFH), Cardigan Fish Hatchery (CFH), Canadian Aquaculture Institute (CAI), and Pork Production Innovation Group (PPIG) are the four divisions of AVC Inc, with three of them being ocean-related. AVC Inc had average sales between $1.5 and $2.0 million of which approximately 26.5% were exported. It directly employed about 40 personnel (full-time equivalent) and had an annual wagebill of over $800 thousand.

Another well-known research and services facility located on the campus of the University of Prince Edward Island is the Food Technology Centre. The Centre is an ISO 9001 registered company established in 1987 to provide scientific and technical expertise to the agriculture and fishing industries. This facility currently employs 30 food scientists, technical and support staff with an estimated $1.3 million dollar annual payroll and annual operating expenditures of close to $3.0 million. It is estimated that between 45 and 55% of the Centre's activities are ocean-related.

UPEI is also the home of the Lobster Science Centre and the Institute of Island Studies. Founded in 1985 the Institute's principal activity has been the initiation and coordination of research projects. It is difficult to determine the ocean-related activities of the Institute. Primary areas of interest are Island culture, sustainable development, land use, agriculture and the knowledge economy. Currently the Institute employs approximately 3.5 staff on a full-time equivalent basis with an estimated annual payroll of $120,000 and annual operating expenditures of between

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[18] See Atlantic Provinces Economic Council (2000).

[19] Ibid.

$150,000 and $300,000. Discussions with Institute personnel indicated that an estimated 20% of their activity is ocean-related.

Private industry also plays a part in ocean-related research and development. Companies such as Northeast Biological Processors, Diagnostic Chemicals and Abegweit Organic Marketing have undertaken R&D in the development of their products. Although this R&D is small in relation to the other high profile organizations discussed previously, it is of great importance to these companies as a way of increasing their markets and developing products to assist in their long-term survival.

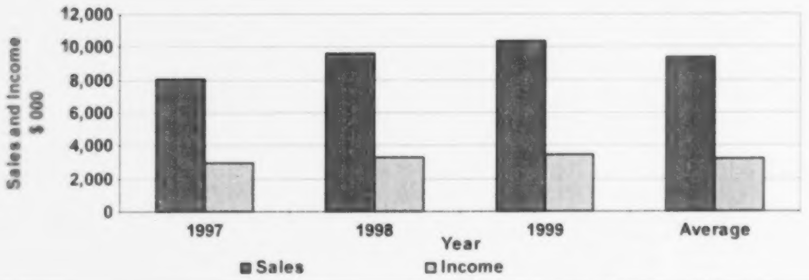
Table 2.12 and Chart 2.18 present the basic data for ocean-related research and services from 1997 to 1999. On average for this period there were sales of $9.4 million supporting 115 employees with an aggregate income of $3.2 million. It is estimated that 60+% of these sales were exported out-of-province and worth approximately $5.6 million per year.

Table 2.12: PEI Ocean-related Research and Other Services: Key Economic Indicators

	1997	1998	1999	Average
Sales ($ 000)	8,090	9,640	10,343	9,358
Exports ($ 000)	4,854	5,784	6,206	5,615
Employment	106	117	124	115
Income ($ 000)	2,984	3,252	3,441	3,213

Source: AVC; AVC Inc; Food Technology Centre; Institute of Island Studies; APEC; Canmac Economics Ltd

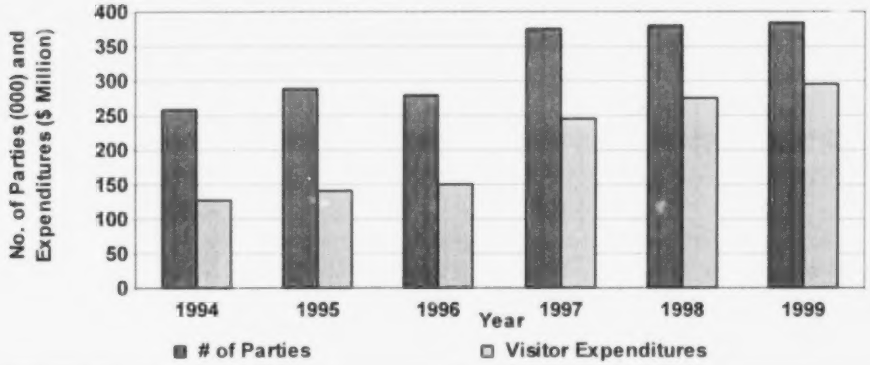
Chart 2.18: PEI Ocean-related Research and Other Services: Key Economic Indicators 1997-1999



2.1.10 Ocean-related Tourism

Tourism is one of the most important industries in PEI, together with fisheries and agriculture. Based on annual sales (output), this industry has seen significant growth in both the number of visitors and visitor expenditures (Chart 2.19).

Chart 2.19: PEI Tourist Visits and Expenditures: 1994-1999



Source: Tourism PEI, Tourism Economic Impact, 2000

Between 1994 and 1999 the number of visitor parties (tourists travelling together in one vehicle) increased from 258,458 to 382,987, an increase of almost 50%. During the same period, tourist expenditures increased from $127.8 million in 1994 to $296.4 million in 1999, an increase of 132% overall and, on average, over 26% per year.

As an island province with a significant tourist draw, it is to be expected that a large percentage of tourists are attracted to ocean-related activities. Measuring the economic value of the ocean-related component of the PEI visitor's vacation is complicated by several factors. Firstly, data do not always exist on visitor expenditures for ocean-related activities (*e.g.*, lobster suppers, etc.). More importantly, much of the value of this activity is non-market based; for example, a scenic drive, going to the beach or coastal bird watching are some of the economic activities that, although having economic worth, do not have an economic value, *i.e.* price. Chapter Four identifies methods of attributing an economic value to these increasingly important environmentally-based activities.

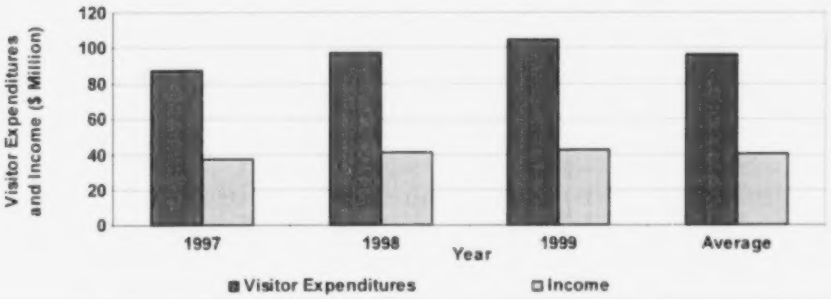
For this study, the approach to measuring the economic value of the ocean to tourism in PEI was a conservative one. An ocean-related tourist was defined as that subset of the total tourist population for which the accessibility of the ocean was a significant component of the decision to visit PEI. Visitor exit surveys ask visitors their primary reason for visiting the Island. Those that responded with an ocean-related activity were counted as an ocean-related tourist and their expenditures were then measured and included in the calculations for this study.

Key economic indicators for tourism are shown in Table 2.13 and Chart 2.20. During the study period, ocean-related tourism drew an average 134,000 visitor parties to the Island. Visitor expenditures averaged over $96 million per year. Tourism activity was estimated to employ approximately 1,600 persons on a full-time equivalent basis and contributed $40.3 million of aggregate income to the economy on an annual basis.

Table 2.13: PEI Ocean-related Tourism. Key Economic Indicators

	1997	1998	1999	Average
Visitor Expenditures ($ 000)	87,049	97,138	104,930	96,372
Visitor Parties (000)	132	135	136	134
Employment (FTE)	1,480	1,651	1,706	1,612
Income ($ 000)	36,996	41,284	42,653	40,311
Source: Tourism PEI; Canmac Economics Ltd				

Chart 2.20: PEI Ocean-related Tourism: Key Economic Indicators 1997-1999



2.2 Government Departments

Five government departments in Prince Edward Island have mandates and responsibilities, wholly or partly, for activities related to the ocean sector.

There are two provincial departments in this category, namely the PEI Department of Fisheries, Aquaculture and Environment and Tourism PEI. Many of the Island's tourist attractions are ocean-related (beaches, fishing villages, coastal communities, etc.); consequently the mandate of Tourism PEI has an ocean-related focus. Other provincial departments have concerns and activities that involve ocean-related matters, for example, the PEI Department of Development and Technology. These provincial departments had expenditures related to ocean activities and, although at times significant, they were not included in this study because they were intermittent and usually on a project-by-project basis.

There are three federal departments in PEI which have mandates and responsibilities, wholly or partly, for activities related to the ocean sector. Included in this group are the Department of Fisheries and Oceans (DFO), which devotes most of its resources to ocean-related activities; Environment Canada, with only a portion of its expenditures being ocean-related; and Parks Canada, with a significant portion of its expenditures being somewhat ocean-related due to the nature of the PEI National Park. Other federal departments have indirect (off-island) activities related to PEI's ocean sector; Public Works and Government Services Canada administers such things as marine construction contracts and the regional office of Environment Canada provides weather and ice forecasting from the Moncton, New Brunswick office.

2.2.1 PEI Department of Fisheries, Aquaculture and Environment

The PEI Department of Fisheries, Aquaculture and Environment is the provincial department with the major interest in the ocean sector. The primary mandate for this department is to assist the sustainable development of the fisheries and aquaculture resources of PEI in order to maximize the contribution of the fishing industry to the economy of the Province in an environmentally sound way.

The Department has undergone a number of changes over recent years, the most significant of which was departmental restructuring to change its responsibilities from Fisheries and Tourism to its present status of Fisheries, Aquaculture and Environment. The Fisheries and Aquaculture Division provides programs and services to both the marine fisheries and aquaculture industries in order to achieve its goals of quality advice, assistance and information to clients. The Division acts as an advocate for the PEI fishing industry and takes part in many species advisory committees with the industry and the federal government, which is responsible for the management of the marine fisheries.

The Fisheries and Aquaculture Division also carries out basic biological research with regard to major fish species, and supports the development of new fisheries. The Division offers programs to support new technology in the fisheries and assists the seafood processors with programs to enhance value-added processing of seafood. In addition, the Division promotes fish quality through the administration of the PEI Fish Inspection Act and the PEI Fisheries Act. This includes responsibility for licensing and inspection of all fish-buying stations and fish-processing facilities.

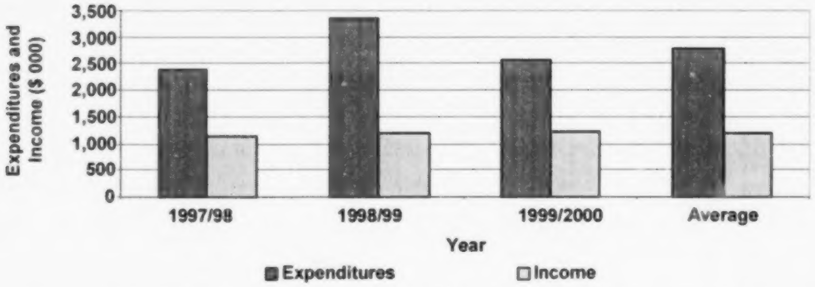
Table 2.14 and Chart 2.21 present the Department's basic data for the study period 1997-1999. Direct departmental expenditures averaged $2.8 million a year, employed 33 persons on a full-time equivalent basis and provided $1.2 million annually of aggregate income.

Table 2.14: PEI Department of Fisheries, Aquaculture and Environment: Key Economic Indicators

	1997/1998	1998/1999	1999/2000	Average
Expenditures ($ 000)	2,410	3,338	2,595	2,781
Employment (FTE)	32	32	34	33
Income ($ 000)	1,143	1,193	1,219	1,185

Source: PEI Department of Fisheries, Aquaculture and Environment

Chart 2.21: PEI Department of Fisheries, Aquaculture and Environment: Key Economic Indicators 1997/1998 - 1999/2000



2.2.2 Tourism PEI

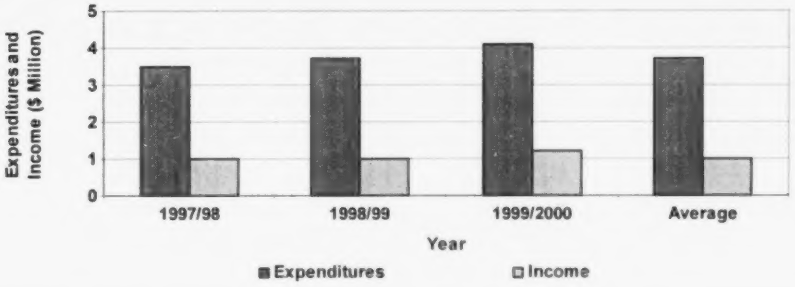
A significant portion of Tourism PEI's annual activity is ocean-related. The Department's mandate is to promote continued growth in the tourism sector; market PEI as a premier destination; facilitate product development; promote special events; provide continued emphasis on customer service; manage provincial infrastructure projects, and facilitate community development through tourism. Tourism PEI consists of four divisions: Development, which has the responsibility for the Island's many parks, visitor information centres and various tourism products; Marketing, which is responsible for all off-island advertising and the development and production of the annual Visitors Guide; Research, which designs and undertakes quantitative and qualitative research projects; and Corporate Services, which supports the day to day operations of Tourism PEI.

In allocating a portion of Tourism PEI's annual activities to the ocean sector, the study team followed the same methodology employed to allocate tourist parties and expenditures. Using information from the 1999 Tourist Exit Survey, it was calculated that 35.4% of tourists stated that an ocean-related activity was their primary reason for visiting PEI. This proportion was also applied to Tourism PEI's annual statistics to identify ocean-related activity.

The Department's data in relation to ocean-related tourism are presented in Table 2.15 and Chart 2.22. On average Tourism PEI expended $3.7 million on ocean-related activities, employed 41 persons on a full-time equivalent basis and contributed annually over $1 million of aggregate income to the provincial economy.

Table 2.15: Tourism PEI: Key Economic Indicators				
	1997/1998	**1998/1999**	**1999/2000**	**Average**
Expenditures ($ 000)	3,477	3,650	4,105	3,744
Employment (FTE)	38	40	45	41
Income ($ 000)	972	1,000	1,170	1,047
Source: Department of Fisheries and Tourism Annual Reports; Canmac Economics Ltd				

Chart 2.22: Tourism PEI:
Key Economic Indicators 1997/1998 - 1999/2000



2.2.3 Department of Fisheries and Oceans

The Department of Fisheries and Oceans (DFO), on behalf of the Government of Canada, is responsible for policies and programs in support of Canada's economic, ecological and scientific interests in the oceans and freshwater fish habitat; for the conservation and sustained utilization of Canada's fisheries resources in marine and inland waters; and for safe, effective and environmentally sound marine services responsive to the needs of Canadians in a global economy. As such, the Department has the federal lead for Canada's oceans agenda within the context of the Oceans Act.

The Canadian Coast Guard, formerly a unit of Transport Canada, merged in 1995 with the Department of Fisheries and Oceans. This merger combined the government's two main civilian marine fleets within one department. DFO is now one of the largest federal departments, with a national budget for 1999-2000 of $1.2 billion and employment of 9,300 personnel.

Most DFO programs in Prince Edward Island are managed through an area office in Charlottetown. The Province is part of the Department's Gulf Region with headquarters in Moncton, NB. Additional offices in PEI are located in Alberton, Montague, Souris and Summerside. Services offered include fisheries conservation and protection, resource management, scientific research, habitat management and small craft harbours. In addition, the Coast Guard delivers various marine safety services in PEI. These services include search and rescue, aids to navigation, marine communications, icebreaking and environmental response, boating safety and navigable waters protection. Coast Guard services delivered in PEI are managed through CCG regional headquarters in Dartmouth, NS rather than via the Gulf Region organization.

During the study period 1997-1999, DFO also had on-island expenditures related to the Atlantic Groundfish License Retirement Program (AGLRP). Under this program a total of 15 groundfish licenses were retired in PEI at a cost of $1.97 million. Additional expenditures were also made under the Aboriginal Fisheries Strategy (AFS) and its Allocation Transfer Program (ATP) for a total of $2.73 million for the three-year period 1997/1998 to 1999/2000. Program funds were used to improve conservation and to acquire commercial licenses, vessels and gear for transfer to aboriginal organizations. Table 2.16 outlines the expenditures by these programs over the study period.

Table 2.16: AGLRP, AFS and ATP Expenditures in PEI

	1997/1998	1998/1999	1999/2000
AGLRP ($ 000)	0.0	1,626.0	340.0
AFS ($ 000)	366.0	377.0	387.5
ATP ($ 000)	249.5	0.0	1,349.9
Total ($ 000)	**615.5**	**2,003.0**	**2,077.4**

Source: Department of Fisheries and Oceans

Although these expenditures were made during the study period, they are not included in the Department's key economic indicators as they are program expenditures (captured elsewhere if valid) and are not normal operational or maintenance expenditures.

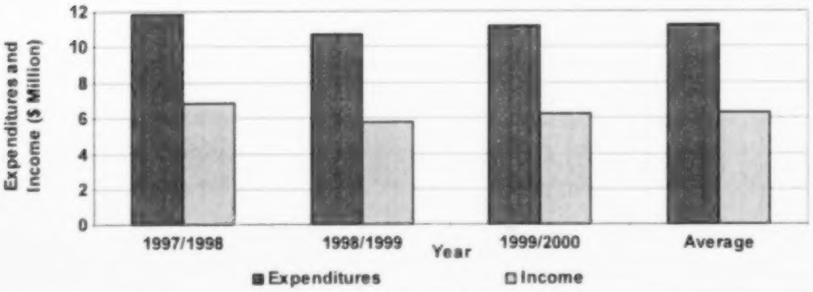
Table 2.17 and Chart 2.23 present the basic data for the Department of Fisheries and Oceans. Average spending by DFO in PEI for 1997/1998 to 1999/2000 was $11.2 million, and average employment was 170 persons (full-time equivalent) contributing an average of $6.3 million per year of aggregate income to the PEI economy.

Table 2.17: Department of Fisheries and Oceans: Key Economic Indicators

	1997/1998	1998/1999	1999/2000	Average
Expenditures ($ 000)	11,781	10,736	11,074	11,197
Employment (FTE)	181	163	167	170
Income ($ 000)	6,829	5,791	6,188	6,270

Source: Department of Fisheries and Oceans

Chart 2.23: Department of Fisheries and Oceans:
Key Economic Indicators 1997-1998 to 1999-2000



2.2.4 Environment Canada

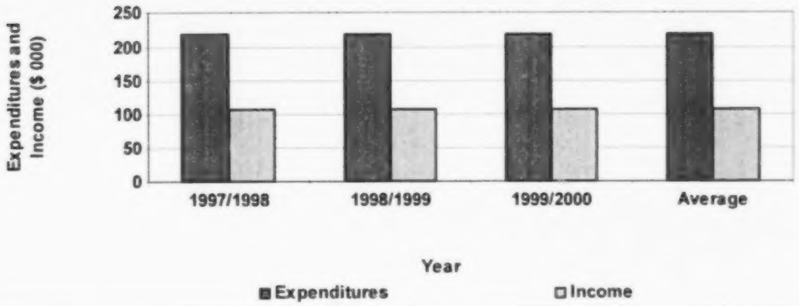
Environment Canada is a science-based department with a mandate which includes preservation and enhancement of the quality of the natural environment, renewable resources (including migratory birds and other non-domestic flora and fauna), meteorology, and coordination of federal environmental policies and programs. Environment Canada is organized into five integrated regions across Canada, including an Atlantic Region based in Dartmouth, Nova Scotia. Environment Canada has approximately 4,900 employees nationally, and a current budget of $546 million.

Environment Canada has a relatively small presence in PEI; much of its support for PEI originates from its regional offices in Moncton and Halifax. These offices provide weather forecasting services, ice condition monitoring and reporting as well as support for the environmental protection office on the Island. Although these regional activities have no direct economic impact (local spending), the services are significant and critical to the PEI ocean sector.

Key data for Environment Canada oceans-related operations in PEI are presented in Table 2.18 and Chart 2.24. Over the study period 1997-1999 department spending was small at $220,000 per year with direct employment of 3 persons (full-time equivalent) with an aggregate income of $107,000 per year contributed to the provincial economy.

Table 2.18: Environment Canada: Key Economic Indicators				
	1997/1998	1998/1999	1999/2000	Average
Expenditures ($ 000)	219	219	219	219
Employment (FTE)	3	3	3	3
Income ($ 000)	107	107	107	107
Source: Environment Canada				

Chart 2.24: Environment Canada:
Key Economic Indicators 1997/1998 - 1999/2000



2.2.5 Parks Canada

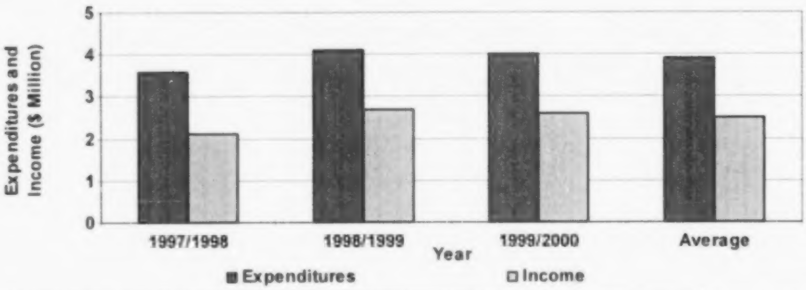
Part of the mandate of Parks Canada is to "protect and present nationally significant examples of Canada's natural and cultural heritage". This best describes PEI from a national perspective.

The Prince Edward Island National Park extends along the north shore of the Island for 40 kilometres from Cavendish to the Dalvay-by-the-Sea Hotel. Therefore the Park, or a large portion of it, can be considered an ocean-related resource. Parks Canada operates the Park as well as a number of national historic sites on the Island, namely Ardgowan, Port-la-Joye/Fort Amherst, and Province House.

Due to the ocean nature of the National Park, Parks Canada's expenditures and employment related to the Park have been included in the study. Table 2.19 and Chart 2.25 present the basic ocean-related data for Parks Canada. On average there were $3.9 million in annual expenditures and annual employment of 83 persons on a full-time equivalent basis with an average annual aggregate income of $2.5 million.

Table 2.19: Parks Canada: Key Economic Indicators				
	1997/1998	**1998/1999**	**1999/2000**	**Average**
Expenditures ($ 000)	3,626	4,140	4,004	3,923
Employment (FTE)	73	90	86	83
Income ($ 000)	2,137	2,690	2,615	2,481
Source: Parks Canada				

Chart 2.25: Parks Canada:
Key Economic Indicators 1997/1998 - 1999/2000



Chapter Three
The Wider Impacts of the Ocean Sector: Direct, Indirect, and Induced Effects

The data used to describe the ocean sector so far in this study provide a first impression of the sector's importance in Prince Edward Island's economy. They can also be used to show the wider impacts of the ocean sector with the use of the Input-Output (I/O) model of the provincial economy. This section begins with a brief description of the I/O model and how it works. There is a more detailed explanation in Appendix B.

An I/O model attempts to relate demand for a sector's output, and its own demand for inputs, to the performance of every other sector in an economy. By including a 'household' sector as well, consumers are built into the model, and how their purchases reverberate through the total economy as the money they earn is spent and re-spent on goods and services.

The three basic impacts to be modelled in this chapter are direct, indirect, and induced. The *direct impact* of the ocean sector is defined as its total value of output, or the values explained in Chapter Two of this study less any double-counting (see below). The *indirect impact* is the total value of output from other sectors as they supply the ocean sector. This includes the 'suppliers of suppliers' to the ocean sector. The *induced impact* refers to the additional industry output that arises as households spend the incomes they earn in the ocean sector or in the suppliers to that sector. The *total impact* is the sum of these three impacts.

3.1 Economic Impact Results

The impact modelling exercise involved taking the values of the direct ocean sector output, derived in the preceding chapter, and estimating their wider impacts. This involved tracing the local spending of each private industry and government department as they purchased goods and services from suppliers. The first step in this process was the elimination of double-counting between each industry and department specified, *e.g.*, fish processing plants purchase fish from the traditional fishery. If the economic impact of the traditional fishery and the economic impact of the fish processing industry were measured in the gross terms explained in Chapter Two, the fish would be counted twice, since each industry counted the fish as part of its respective output. To avoid this, inter-industry sales between ocean-related activities were eliminated.

It should be noted that this in no way detracts from the value or importance of the industry that 'loses' the double-counted share; the value is usually awarded to the higher value-added activity, for example, in the case of fishing and fish processing, to the latter. It is probable that a large proportion of the output of traditional fishing was, in fact, bought by fish plants in PEI, and this represents the most significant example of double counting. To offset double-counting within the fish-related industries (excluding aquaculture), only the direct impact of traditional fishing was reported in Tables 3.1 through 3.5. The indirect and induced impacts of traditional fishing were included with fish processing. Although this understated the wider impacts of traditional fishing, because some fish were sold directly into export markets or to final consumers, incomplete data precluded more precise calculation. Other inter-industry sales were probably very small, although they can be imputed - traditional fishing, for example, buys most of the output of boatbuilding, but as this is lumped with shipbuilding, this double-counting would be very small and would not show up in the modelling.

3.2 GDP Impact

Direct GDP of the private sector ocean-related industries in PEI amounted to $236.1 million (Table 3.1 and Chart 3.1). Estimating the indirect and induced impacts (accomplished by means of 'multipliers' built into I/O models), the *total* GDP accounted for by these industries comprised $405.9 million or 16.5% of PEI's total GDP ($2.46 billion). The largest contributor to total GDP was fish processing. When fish processing was combined with traditional fishing, the total GDP impact was $233.4 million. This represents 57.5% of the total GDP contributed by the private ocean-related industries, or 9.5% of the provincial economy. The addition of aquaculture GDP to fish processing and traditional fishing increased the total number to $246.4 million, or 10% of PEI's GDP.

There were other important ocean-related industry contributors to the provincial economy, notably tourism and transportation. The top five industries (three fish-related, tourism and transportation) together dominated the private industry component of the ocean sector and contributed approximately 90% of total private industry GDP. The other industries were worth $41 million in terms of GDP but are especially important because of their growth potential, i.*e.* marine technology and research services.

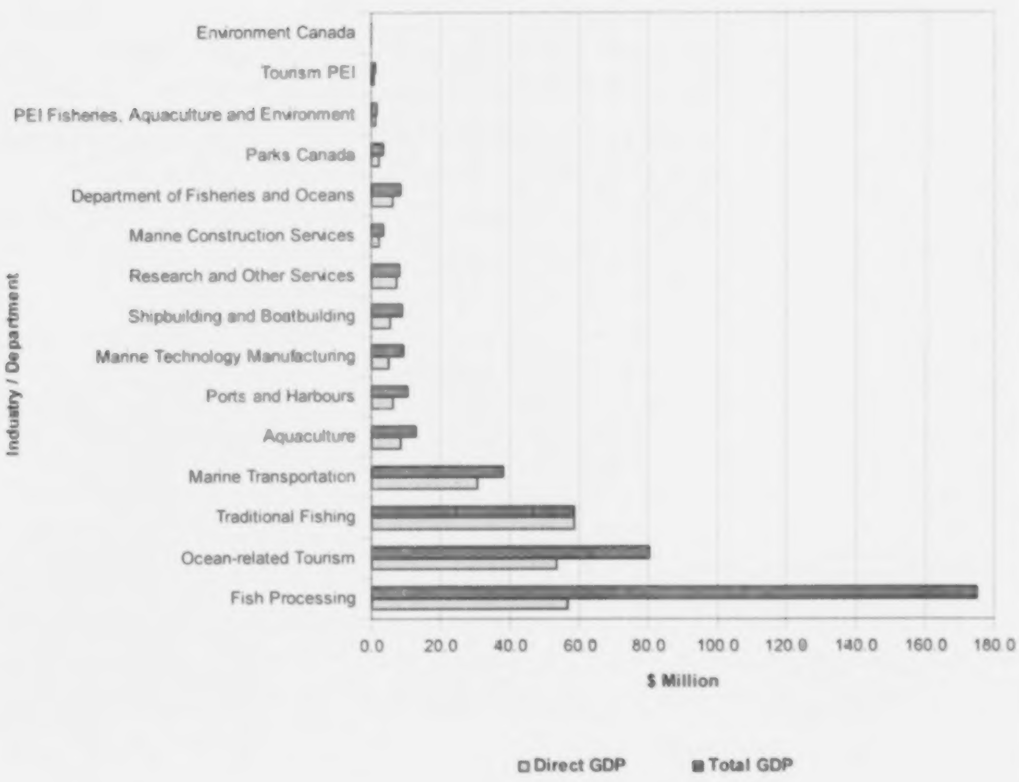
Activities of government departments in terms of GDP were dominated by DFO, although contributions by the PEI Department of Fisheries, Aquaculture, and Environment and Tourism PEI were significant. It is interesting to note that direct government activity was a small share (less than 4.5%) of all ocean sector enterprise, in spite of the government's responsibilities for managing and regulating marine resource use and activities.

Table 3.1: The Ocean Sector in PEI:
Gross Domestic Product Impacts, Average of 1997, 1998 and 1999
($ Million, ranked by total GDP within sub-groups)

	Output	Direct GDP	Total GDP	% of Sub-total	% of Grand Total
Private Industry					
Fish Processing	221.9	56.7	174.6	43.0	41.4
Ocean-related Tourism	96.4	53.7	80.3	19.8	19.0
Traditional Fishing	123.3	58.8	58.8	14.5	14.0
Marine Transportation	65.4	30.9	38.2	9.4	9.1
Aquaculture	19.8	8.6	13.0	3.2	3.1
Ports and Harbours	(a)	6.2	10.5	2.6	2.5
Marine Technology Manufacturing	12.9	5.3	9.5	2.3	2.3
Shipbuilding and Boatbuilding	16.9	5.8	9.1	2.2	2.1
Research and Other Services	9.4	7.4	8.2	2.0	2.0
Marine Construction Services	4.2	2.5	3.7	0.9	0.9
Sub-total	**570.1**	**236.1**	**405.9**	**100.0**	**96.3**
Government Departments					
Department of Fisheries and Oceans	11.2	6.3	8.7	56.5	2.1
Parks Canada	3.9	2.5	3.5	22.4	0.8
PEI Department of Fisheries, Aquaculture and Environment	2.8	1.2	1.6	10.7	0.4
Tourism PEI	3.7	1.0	1.5	9.4	0.3
Environment Canada	0.2	0.1	0.1	1.0	(b)
Sub-total	**21.9**	**11.1**	**15.4**	**100.0**	**3.7**
Grand Total	**592.0**	**247.2**	**421.4**		**100.0**

Note (a) Dollar output figure for ports was not available.
Note (b) Less than 0.05%. Totals may not add up due to rounding.
Source: Computed by Canmac Economics Ltd

Chart 3.1: The Ocean Sector in PEI:
Gross Domestic Product Impacts, Average of 1997, 1998 and 1999



3.3 Household Income Impacts

People working in the ocean sector in PEI generated a total household income of $302.4 million, or 19.8% of the PEI total ($1.5 billion) as measured by official data for total wages and salaries (Table 3.2 and Chart 3.2). With regard to household income, fish processing was, once again, ranked number one, followed by the traditional fishery and then tourism. The fact that industry rankings changed for household income *vis-à-vis* GDP can partly be explained by the fact that some industries are more labour intensive than others. Combining the three fish-related activities (fish processing, traditional fishing and aquaculture) resulted in a total household income of $192.9 million, or 12.6% of total household income in PEI.

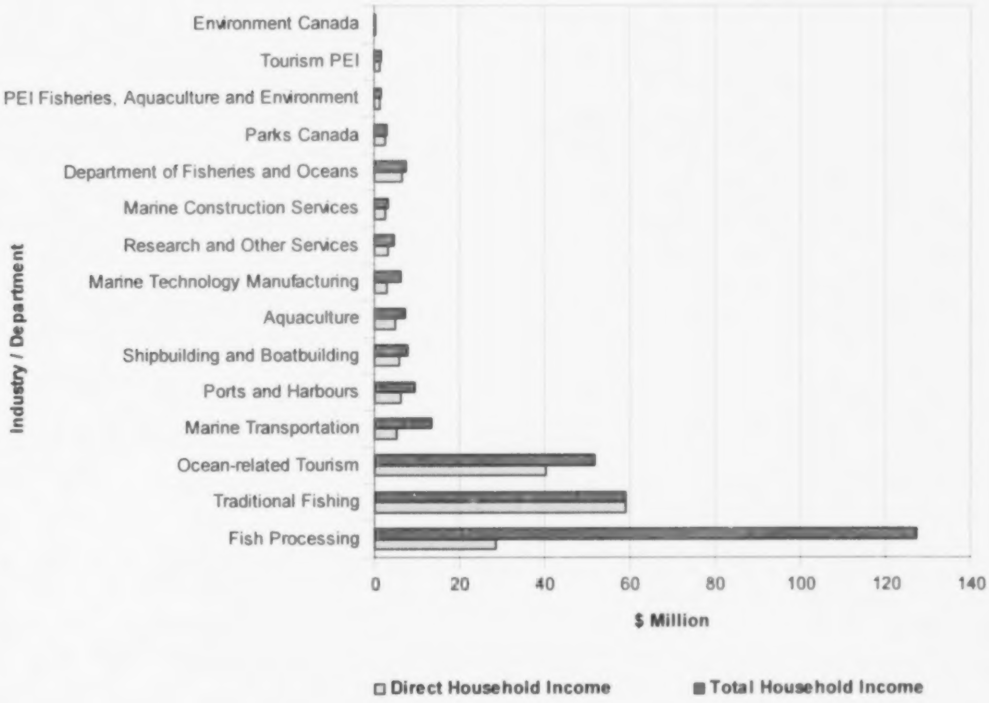
Of the government departments, DFO once again dominated. The Department in total had a bigger share of total household income, about 2.5% of the total for the ocean sector compared with 2.1% of GDP (Table 3.4), due to generally higher wages paid by governments.

Table 3.2: The Ocean Sector in PEI: Household Income Impacts, Average of 1997, 1998 and 1999 ($ Million, ranked by total impact within sub-groups)

	Direct Household Income	Total Household Income	% of Sub-total	% of Grand Total
Private Industries				
Fish Processing	28.4	126.9	43.9	42.0
Traditional Fishing	58.8	58.8	20.4	19.5
Ocean-related Tourism	40.3	51.7	17.9	17.1
Marine Transportation	5.0	13.4	4.7	4.4
Ports and Harbours	6.2	9.3	3.2	3.1
Shipbuilding and Boatbuilding	5.8	7.8	2.7	2.6
Aquaculture	4.8	7.2	2.5	2.4
Marine Technology Manufacturing	2.8	6.2	2.1	2.0
Research and Other Services	3.2	4.3	1.5	1.4
Marine Construction Services	2.5	3.0	1.0	1.0
Sub-total	**157.8**	**288.8**	**100.0**	**95.5**
Government Departments				
Department of Fisheries and Oceans	6.3	7.5	55.6	2.5
Parks Canada	2.5	2.9	21.5	1.0
PEI Department of Fisheries, Aquaculture and Environment	1.2	1.5	11.2	0.5
Tourism PEI	1.0	1.5	10.7	0.5
Environment Canada	0.1	0.1	1.0	(a)
Sub-total	**11.1**	**13.6**	**100.0**	**4.5**
Grand Total	**168.9**	**302.4**		**100.0**

Notes (a) Less than 0.05%. Totals may not add up to100% due to rounding
Source: Computed by Canmac Economics Ltd

Chart 3.2: The Ocean Sector in PEI:
Household Income Impacts, Average of 1997, 1998 and 1999



3.4 Employment Impacts

Total employment created by the ocean sector in PEI (Table 3.3 and Chart 3.3) mirrored the household income impact. Total employment in both private industries and government departments was 11,722 full-time equivalent jobs on average for 1997, 1998 and 1999. This represented 19.5% of the average total employment in PEI (*i.e.* approximately 60,000 FTE) for the same period. Thus, about one job in five in the Province could trace its origin directly or indirectly to the ocean sector.

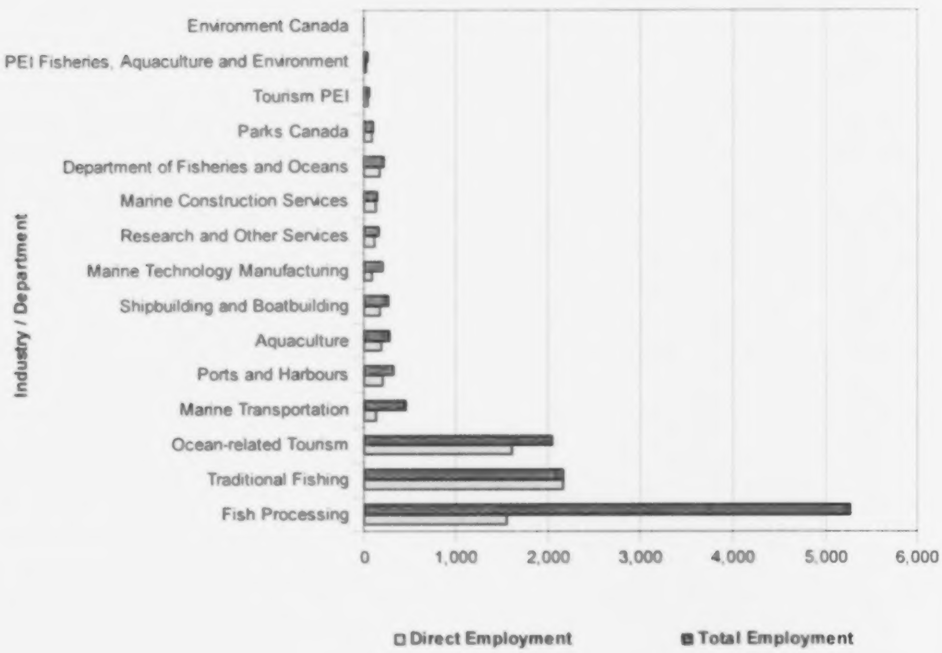
Table 3.3: The Ocean Sector in PEI:
Employment Impacts, Average of 1997, 1998 and 1999
(ranked by total impact within sub-groups)

	Direct Employment	Total Employment (FTE)	% of Sub-total	% of Grand Total
Private Industries				
Fish Processing	1,554	5,262	46.6	44.9
Traditional Fishing	2,173	2,173	19.2	18.5
Ocean-related Tourism	1,612	2,042	18.1	17.4
Marine Transportation	133	452	4.0	3.9
Ports and Harbours	204	319	2.8	2.7
Aquaculture	191	283	2.5	2.4
Shipbuilding and Boatbuilding	182	259	2.3	2.2
Marine Manufacturing Technology	82	208	1.8	1.8
Research and Other Services	115	158	1.4	1.3
Marine Construction Services	125	143	1.3	1.2
Sub-total	**6,371**	**11,298**	**100.0**	**96.4**
Government Departments				
Department of Fisheries and Oceans	170	218	51.5	1.9
Parks Canada	83	99	23.5	0.8
Tourism PEI	41	56	13.3	0.5
PEI Department of Fisheries, Aquaculture and Environment	33	45	10.7	0.4
Environment Canada	3	4	0.9	(a)
Sub-total	**330**	**423**	**100.0**	**3.6**
Grand Total	**6,701**	**11,722**		**100.0**

Note (a) Less than 0.05%. Totals may not add up to 100% due to rounding.
Source: Computed Canmac Economics Ltd

The relative ranking of private industries and government departments with regard to employment impacts was similar to the household income ranking. For private industries, fish processing was first, followed by traditional fishing, tourism and then transportation. Fish-related activities accounted for 68.3% of all private industry employment; tourism and transportation accounted for another 22.1%. There were particularly impressive indirect and induced impacts in terms of employment for several industries, such as fish processing and aquaculture. For example, for every direct job created in fish processing three others were created in other industries. Marine technology manufacturing and transportation also had significant multipliers.

Chart 3.3: The Ocean Sector in PEI: Employment Impacts, Average of 1997, 1998 and 1999



3.5 Summary of Total Impacts

The total economic impact of PEI's ocean sector is summarized in Table 3.4. All of the industries and departments combined accounted for 17.1% of PEI's total GDP, 19.8% of household income and 19.5% of total employment. Almost all of this impact (96.3% of GDP, 95.5% of household income, and 96.4% of employment) was contributed by private industry. This is in sharp contrast to the situation in Nova Scotia, where a much larger proportion of the total impact of the ocean sector is derived from governments, weighted significantly by the fact that Halifax is the base for most of Canada's navy[20].

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[20] See Mandale Consulting, Canmac Economics and the North American Policy Group (1998).

Of the five biggest industries, fish processing, tourism and traditional fishery dominated, but aquaculture and transportation also made significant contributions. The five smallest industries included ports and harbours, marine technology manufacturing, shipbuilding and boatbuilding, research services, and marine construction services.

DFO contributed the largest proportion of the total economic impact derived from governments. The importance of DFO's management, regulatory and safety functions in PEI is reflected in the Department's ranking.

Table 3.4 ranks all ocean-related activities by size of GDP, and not by private industry and government department sub-groups as in Tables 3.1 through 3.3.

Table 3.4: The Ocean Sector in PEI:
Summary of Total Economic Impacts, Average of 1997, 1998 and 1999

	Total GDP	Total Household Income	Total Employment (FTE)	Overall Rank by GDP
	$ Million			
Fish Processing	174.6	126.9	5,262	**1**
Ocean-related Tourism	80.3	51.7	2,042	**2**
Traditional Fishing	58.8	58.8	2,173	**3**
Marine Transportation	38.2	13.4	452	**4**
Aquaculture	13.0	7.2	283	**5**
Ports and Harbours	10.5	9.3	319	**6**
Marine Technology Manufacturing	9.5	6.2	208	**7**
Shipbuilding and Boatbuilding	9.1	7.8	259	**8**
Department of Fisheries and Oceans (a)	8.7	7.5	218	**9**
Research and Other Services	8.2	4.3	158	**10**
Marine Construction Services	3.7	3	143	**11**
Parks Canada (a)	3.5	2.9	99	**12**
PEI Department of Fisheries, Aquaculture and Environment (a)	1.6	1.5	45	**13**
Tourism PEI (a)	1.5	1.5	56	**14**
Environment Canada (a)	0.1	0.1	4	**15**
Total Private Industry	**405.9**	**288.8**	**11,298**	
Total Government Department (a)	**15.4**	**13.6**	**423**	
Grand Total	**421.4**	**302.4**	**11,722**	

Note (a) Public sector.
Source: Computed by Canmac Economics Ltd

The ocean sector, it must be emphasized, is dynamic and shifting. For example, the declining shipbuilding recently rebounded because of tugboat orders at East Isle Shipyard. Aquaculture has potential to grow, as do some of the smaller industries mentioned above. Public sector activity is less variable, although budgets were reduced during the 1990s at a time when pressures on ocean-related resources were increasing.

It is instructive to do another division of the impact data shown in Table 3.4 to show the relative importance within private industries of those that depend on the ocean as a resource, and those that use the ocean as a medium of operation or movement. This is shown in Table 3.5.

Table 3.5: The Ocean Sector in PEI: Total Impacts by Resource Dependent and Non-resource Dependent Private Industries, Average of 1997, 1998 and 1999

	Total GDP	Total Household Income	Total Employment (FTE)
	$ Million and % of total		Number and % of total
Resource Dependent Industries (a)	326.7 80.5%	244.6 84.7%	9,760 86.4%
Non-resource Dependent Industries (b)	79.2 19.5%	44.2 15.3%	1,538 13.6%

Notes (a) Fish processing, traditional fishing, aquaculture and tourism.
(b) Other private industries.
Source: Computed by Canmac Economics Ltd

Table 3.5 indicates that resource dependent private industries accounted for more than 80% of the activity. Given the decline in non-resource dependent industries such as shipbuilding, this percentage will have increased subsequent to the period under study. The percentage would further increase if some of the non-resource dependent industries, such as boatbuilding and marine construction, sold much of their output to resource dependent industries.

The quality of the ocean-related environment is critical, therefore, to the majority of private industry activities that make up most of PEI's ocean sector, whether this share is measured in terms of Gross Domestic Product, household income, or jobs.

Chapter Four
Reconciling Economics and the Environment

The concept of GDP was introduced in the 1940s and has been further developed and refined since that time. In the 1970s, the paradigm of environmental economics emerged and gained prominence. It considers the important economic impact of pollution and the economic values which can be attributed to non-market environmental assets and services.

GDP, especially as generated in markets, was the subject of the previous chapters. This chapter provides an introduction to current perspectives, concepts and methodologies of environmental economics which can be applied to the ocean sector in Prince Edward Island.

4.1 The Challenge

Two functional perspectives have been discussed in this study regarding the importance of the ocean. One is the market value of the productive resources drawn from the ocean, *e.g.*, commercial fisheries, aquaculture, etc. The other is the market value of those ocean-related industries that use the ocean as a medium, *e.g.*, transportation. The value of the ocean to the PEI economy, therefore, is a reflection of the willingness of people to pay for its use and is measured by market prices. However, there are important values associated with coastal and ocean resource systems that do not trade in organized economic markets and do not have directly observable prices by which their economic importance can be gauged. For example, wetlands provide flood protection, help to clean water, act as a nursery for many marine species and provide a habitat for waterfowl, but these services are not priced. If these non-market aspects were not important, then their exclusion would not be a problem. This is not the case. Thus in future studies it will be important to broaden the inquiry to include estimates of the value of critical non-market attributes. This perspective is at the leading edge of current environmental economic thinking.

When the economic accounting system treats non-market uses of coastal and ocean resources as 'free', *i.e.* having a zero price, the opportunity costs of production and all of the benefits of nature's functions are not accounted. An opportunity cost is a benefit foregone, *e.g.*, if wetlands are paved, the natural benefits of the wetland are lost and constitute a cost to society. This is true whether or not it occurs in organized markets or in non-market spheres. The failure to account for these values means that the real benefits to society of ocean-related production are over represented, since the full cost to society of all resources (market and non-market) used in production are not included in the accounts. In order to better understand this problem, the 'meaning' of resources, particularly coastal and ocean resources, needs to be addressed more clearly.

4.2 Natural Resources and Functions of Nature

Traditional economic thinking treats resources as 'free' gifts of nature. In other words, the fish, forests or productive soils are there 'for the taking'. How they are produced, and by what non-market ecological process, has not to date been part of traditional economic analysis; scarcity of natural resources is only seen as a function of their economic availability and extraction cost.

Natural resources are traditionally divided into three categories:

- *Renewable resources* are those that are capable of producing a continuous or even increasing output if the stock is not over-exploited, *e.g.*, fish, forests and agricultural land.
- *Non-renewable resources* are those that over any reasonable timeframe for human populations cannot regenerate themselves, *e.g.*, fossil fuels, minerals and sub-surface water aquifers.
- *Continuous resources*, sometimes classed as a renewable resource, includes solar, geomagnetic, tidal and wind energy. They are available continuously (not limited in quantity) but at limited rates of flow.

However, an additional category of resources acknowledges the significance of ecological systems:

- *Environmental resources and services* include natural systems as a source of raw materials and as a sink for waste. They also include beautiful vistas and scientific knowledge that can be attributed to nature.

This expanded resource categorization is a useful step beyond the narrower traditional definition of marketed resources as it facilitates the integration of market and non-market resources into economic analysis.

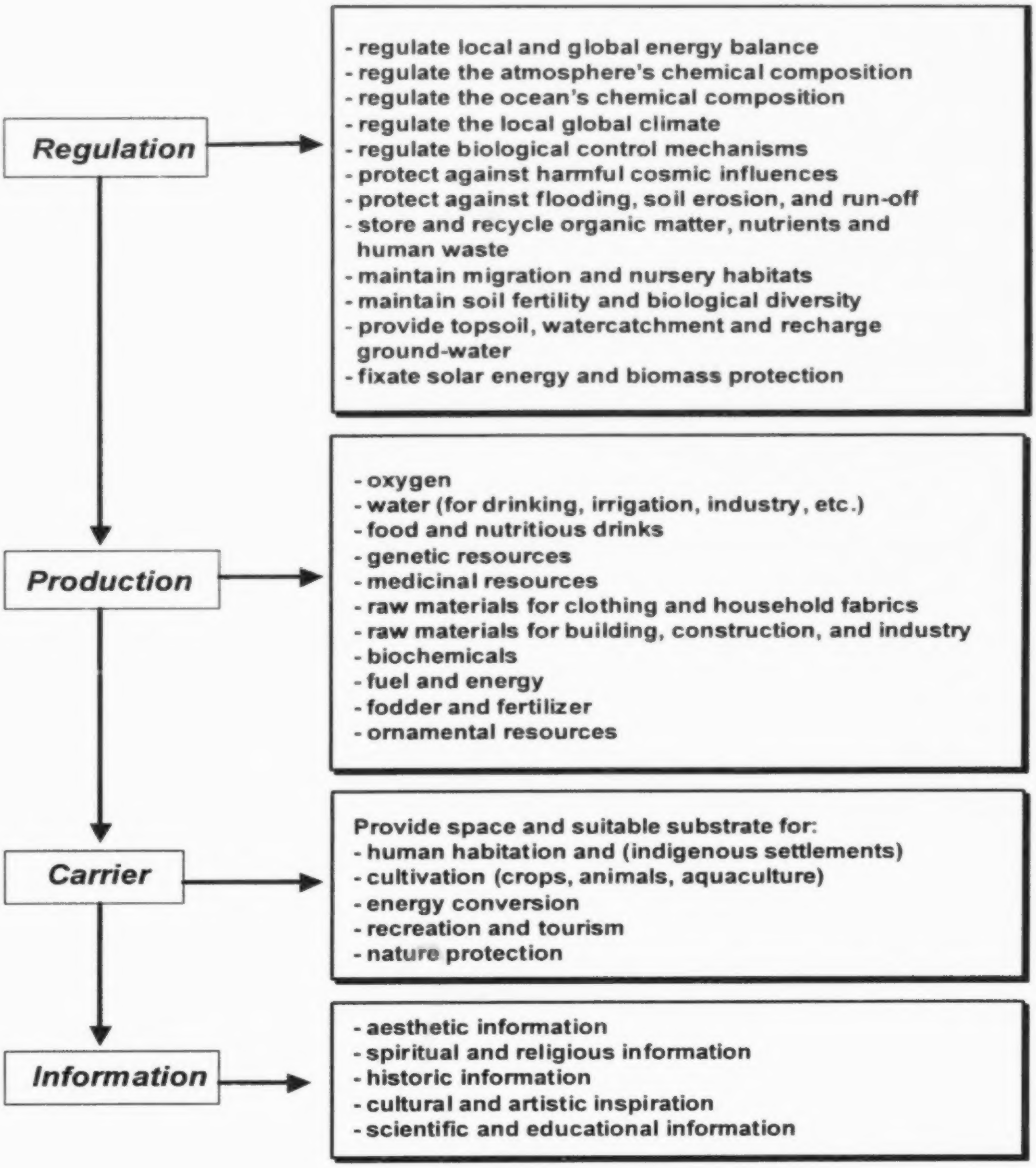
Identifying specific ecological functions is another way to look at resources. This approach was formulated by the Dutch ecologist Rudolf S. de Groot in order to better facilitate the incorporation of nature's full range of functions in environmental planning, management and decision making[21]. De Groot sees his framework as a means to integrate ecology and economy.

Figure 4.1 identifies and provides examples of the four functions of nature that are important to an economy, namely regulation, production, carrier and information functions. This categorization cuts across market and non-market phenomena.

---

[21] See de Groot (1992). Much of the same explanation is presented in a shorter article by de Groot: "Environmental Functions and the Economic Value of Natural Systems" in Jansson, Hammer, Folke and Costanza , editors (1994)., pp. 151-167.

Figure 4.1: The Functions of Nature



Regulation

- regulate local and global energy balance
- regulate the atmosphere's chemical composition
- regulate the ocean's chemical composition
- regulate the local global climate
- regulate biological control mechanisms
- protect against harmful cosmic influences
- protect against flooding, soil erosion, and run-off
- store and recycle organic matter, nutrients and human waste
- maintain migration and nursery habitats
- maintain soil fertility and biological diversity
- provide topsoil, watercatchment and recharge ground-water
- fixate solar energy and biomass protection

Production

- oxygen
- water (for drinking, irrigation, industry, etc.)
- food and nutritious drinks
- genetic resources
- medicinal resources
- raw materials for clothing and household fabrics
- raw materials for building, construction, and industry
- biochemicals
- fuel and energy
- fodder and fertilizer
- ornamental resources

Carrier

Provide space and suitable substrate for:

- human habitation and (indigenous settlements)
- cultivation (crops, animals, aquaculture)
- energy conversion
- recreation and tourism
- nature protection

Information

- aesthetic information
- spiritual and religious information
- historic information
- cultural and artistic inspiration
- scientific and educational information

Source: de Groot 1992:15

These categories are briefly described by de Groot in the following way:[22]

1. *Regulatory Functions* relate to the capacity of natural and semi-natural ecosystems to regulate essential ecological processes and life support systems which, in turn, contribute to the maintenance of a healthy environment by providing clean air, water and soil;
2. *Production Functions* encompass nature's role in providing many resources, *e.g.*, food and raw materials for industrial use and energy resources;
3. *Carrier Functions* are derived from those natural and semi-natural ecosystems that provide space and a suitable substrate, or medium, for many human activities such as habitation, cultivation, recreation and transportation; and
4. *Information Functions* include the numerous ways that natural ecosystems contribute to the maintenance of mental health by providing opportunities for reflection, spiritual enrichment, and aesthetic experience (a beautiful seascape, for instance). They also include vital scientific and educational information.

4.3 PEI's Non-marketed Ocean Resources

Prince Edward Island is clearly influenced by its proximity to the ocean. While the land area is just over 5,660 km^2, the area of near-coastal waters is four or five times that size. The length of coastline is 1,836 km and no point on the Island is more than 30 km from the ocean.[23] PEI is a distinct geographic sub-region in Atlantic Canada. Its land mass belongs to the red sandstones of the Maritime geosyncline, the gentle relief of which is well suited to agriculture[24].

PEI has five watershed regions, identified in Figure 4.2[25]. They each encompass river systems that are important for land-based resource systems such as agriculture and forestry. The drainage from these systems also provides a pathway for a number of pollutants to coastal areas, estuaries and the open sea. PEI has a rich coastal and marine environment that encompasses important estuaries and coastal zones, salt water wetlands or marshes, wildlife habitat, productive fishing grounds with many different species and nationally important ecological reserves and parks.

In previous chapters of this study, the elements of the provincial economic structure that are functionally related to the ocean and their respective proportion of the Province's GDP have been examined. These ocean-related functional elements, *e.g.*, traditional fishing, are all observable in markets where values are expressed by market prices.

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[22] The wording is paraphrased from de Groot (1994), p 152.

[23] Environment Canada (1994), "Our Environmental Resource Base", pp. 23 - 98 provides a recent comprehensive assessment for the Atlantic Region, including references to PEI throughout the text.

[24] See Putnam and Putnam (1970), pp. 114-122.

[25] This map was provided by the PEI Department of Fisheries, Aquaculture and Environment and is only intended to generally illustrate an idea of key watershed regions.

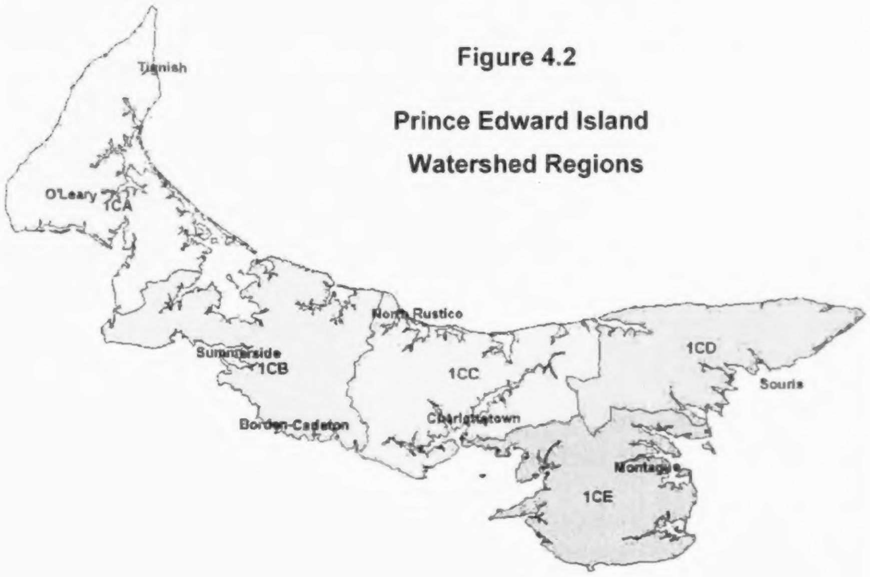

Figure 4.2

Prince Edward Island Watershed Regions

What is not demonstrated in the current analysis is the relationship between the economic structure of markets and the underlying relationships with biophysical or ecological systems. This is information that almost entirely exists in a non-market sphere, *i.e.* there are no directly measurable market prices to demonstrate their economic importance. This includes non-market ecological systems such as soils, forest ecology and aquatic ecosystems that support the resource base on which the economy draws as well as the capacity of nature to safely process waste from economic activity. A literature search has not revealed any detailed contemporary overviews of the biophysical ecological base of the PEI economy. This is work that should be undertaken because such information is needed to identify important functions of nature which have relevance to economic development.

There are, however, some corollary studies of marine ecosystem services that are indicative of what is generally important in marine areas such as PEI[26]. They illustrate a number of ways that non-marketed ocean ecosystems may provide present and future economic value in PEI. These may include: (1) global materials cycling, *e.g.*, carbon sequestration (*i.e.* storage) in ocean ecosystems, (2) transformation, detoxification and sequestration of pollutants, and societal wastes, *e.g.*, run-off from agricultural lands and municipal waste, (3) support of the coastal ocean-based recreation, tourism and retirement industries, *e.g.*, nice beaches, aquatic wildlife and beautiful vistas, (4) coastal land development and valuation, *e.g.*, maintenance of property

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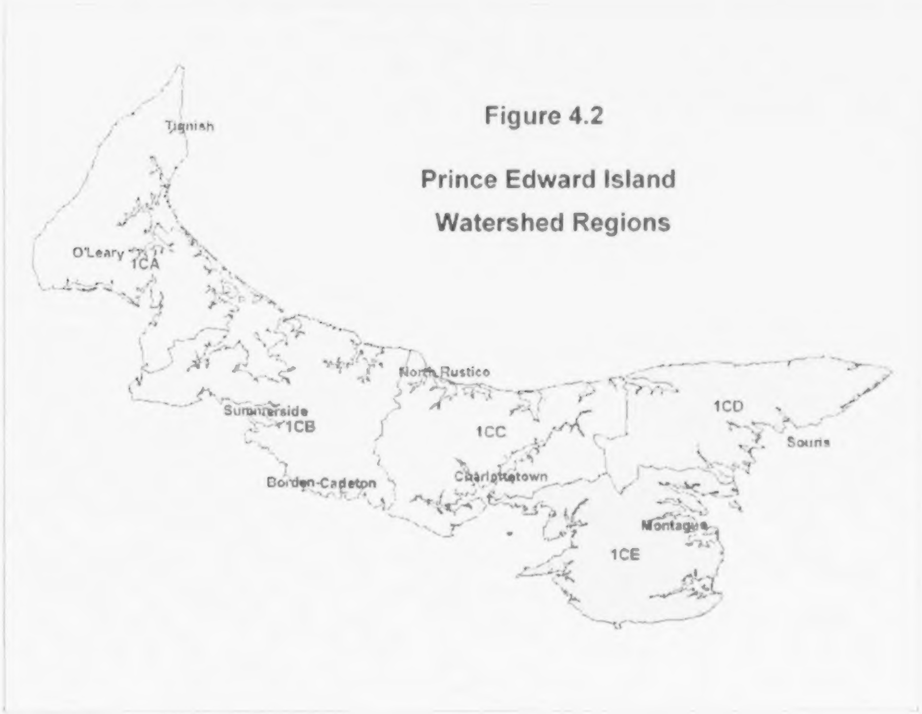
[26] See chapters from Daily (1997) by Peterson and Lubchenco, and by Kaufman and Dayton.



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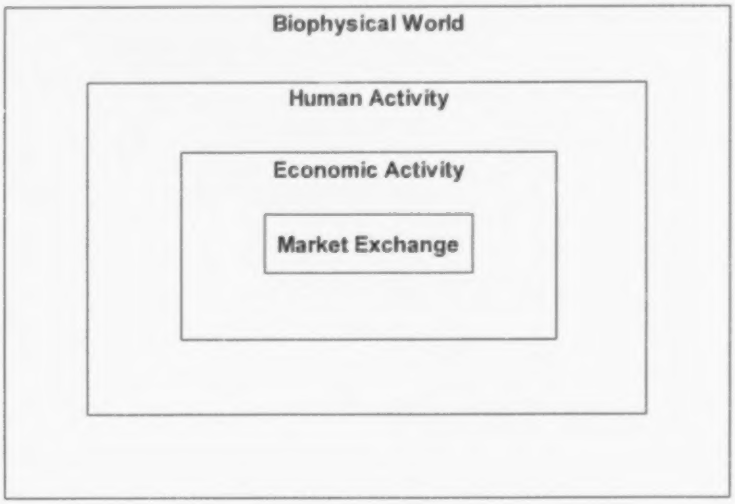
[26] See chapters from Daily (1997) by Peterson and Lubchenco, and by Kaufman and Dayton.

4.4 Moving from a Linear Throughput Model to a Systems Perspective

When resources and the ecological processes that create them are detached from each other, economic thinking views production as a linear throughput, *i.e.* resources are extracted from nature and transformed by production to marketable products that are consumed by individual buyers. The product's utility is measured by the price users are willing to pay. No question is raised about the dependence of economic production on the environment, which is outside the scope of traditional economic analysis. Figure 4.3 describes the real situation, with pure market exchange at its core, dependent upon both human activity (social organization) and upon the extent of the biophysical systems.

Figure 4.3: Economy - Environment Interactions



Source: Gowdy and O'Hara (1995)

A truly circular economic flow, in contrast to linear throughput, may be conceived by focusing on the store of nature's resources. This is achieved by recognizing two basic physical realities. Firstly, all matter and energy used in economic processes are neither created nor destroyed, but rather transformed. That is, the stock of natural resources doesn't just appear or go away through use, it is changed from one state to another. Secondly, no transformation is 100% efficient, therefore each transformation results in a diminishing level of useful work being obtained from materials and energy as they are used.

The recognition of these two physical realities (the Laws of Thermodynamics) forces us to deal with the balance of materials and energy in economic processes. Some resources can be recycled and production technology can be designed that are more resource-efficient. However, there will always be some waste, *i.e.* products no longer useful for new work, given current states of technology. Some of this waste can be safely assimilated by nature, but any remaining waste may detract from or damage the resource base[27].

This conceptual model is thus a systems approach for understanding environment-economy interaction. When this perspective is adopted, it also becomes clear that the division between land and sea is not easily maintained, *i.e.* they are interdependent. A systems perspective is necessary in order to move beyond reliance on market-based measurements alone for determining the importance of ocean-related resources to PEI's economy. These steps are necessary for charting the path toward achieving sustainable development. Appendix E provides a more detailed description of the system perspective model, also known as the materials balance model.

4.5 Balancing PEI's Resource and Waste Flows

The model described above has a number of implications for future data collection and analyses with regard to the importance of PEI's ocean sector.

Firstly, continued prosperity in PEI's ocean industries is dependent upon the maintenance of a healthy stock of resources (natural capital). It can, when properly managed, continue to provide the services of nature needed for creating future economic 'well-being'. Thus Island industries must not deplete the stock of ocean resources such that their annual yield (income) is diminished by over-exploitation. In future analyses of Island economic development, information about how market-based economic activity impinges upon the critical stock of resources must be incorporated into the analyses so that appropriate limits can be placed upon their exploitation.

Secondly, waste flows in the PEI economy, which may affect ocean ecosystems, originate in the resource extraction, production and consumption processes in both land-related and ocean-related economic activity. For example, the run-off from agriculture may exceed the assimilative capacity of ocean ecosystems. This may cause Islanders a loss of economic 'well-being' from the diminished capacity of ecosystems to handle waste, and from the consequent reduction of the economic value of resource systems. The most obvious examples will be loss of productivity in the fishery and aquaculture sectors, or in marine tourism. More information is needed to determine how economic output impacts upon the environment; this includes learning more about the assimilative capacity of critical ecosystems.

Thirdly, there exist opportunities for PEI's industries to undertake actions, in addition to those already underway, which will protect resource stocks and assimilative capacity to a greater degree. These include: (1) making use of more environmentally efficient technologies and processes in resource extraction, production and consumption; and (2) recycling waste so that it does not flow into the environment and, in effect, is treated as a resource[28]. Future studies must include knowledge of resource utilization and waste creation in economic activity; renewable energy as a part of total energy use; and recycling as a proportion of total resource use. In the next section approaches to recently developed resource and environmental accounting methods are explored.

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[27] See Pearce and Turner (1990), pp. 29-42.

4.6 A Structure for Extended Input-Output Accounts for PEI

There exists in Canada, and in most countries in the world, a System of National Accounts (SNA) that produces the Income and Expenditure Accounts on a regular basis. It is from the SNA that estimates of GDP are derived for the nation and for individual provinces. The SNA also produces Canada's Input-Output (I/O), or inter-industry, accounts and is the basis for the provincial I/O model which was used for this study.

Canada has been a leader in extending the I/O accounts to include environmental and resource accounts that make possible a better integration of environment and economy. They include: natural resource stock accounts; material and energy flow accounts; and environmental protection expenditure accounts. The first two are presented in physical quantities and correspond to an accounting for the resource and sink (waste) functions of nature. More detailed information about current approaches to extended Input-Output accounts in Canada is contained in Appendix F.

Extended Input-Output accounts can be applied to PEI; however, they must be tailored to fit the unique economic and ecological structure of the Island. While it is useful to focus upon economic functions that are ocean-related, it is essential to deal also with the land-related economic functions to understand more about the linkage between the economy and the environment. For example, the agricultural industry applies a variety of organic and inorganic materials to the land that may have negative impacts on ocean resource systems. This will frequently happen when run-off from the land makes its way to the sea by way of watershed drainage systems.

Figure 4.4 shows in summary the structure of an extended Input-Output model for PEI that can highlight the importance of both land-related and ocean-related industries to the Island's economy, and that can also provide significant information about the linkage of these two broad categories to the environment. The former is accomplished with the GDP methodology presented earlier in this study. The latter is achieved by constructing two satellite accounts. The first one links market-related economic activity to the use of environmental resource commodities, the production of which comes from non-market natural resource systems. The second one links the output of land-related and ocean-related industries to the discharge of wastes into the environment. These two non-market satellite accounts are expressed in physical units rather than monetary value. Thus they lie outside the main Input-Output framework, but provide links to the source and sink functions of nature.

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[28] PEI already has made good progress in many aspects of recycling household and industrial waste. However, all societies have only begun to realize the full range of opportunities for transforming waste in one sector to a useful input in another.

Figure 4.4 shows the main structure of the Input-Output model within the solid line. The dotted line shows what is called the inter-industry matrix, *i.e.* the flows between the land-related and the ocean-related sectors. The two satellite accounts are outside the main model and present their information in physical terms. They are nevertheless functionally linked to the core I/O model. Work is underway to develop the methodology for bringing important parts of the resource and environmental accounts, in dollar terms, into the I/O model. For example, an accounting of the economic value of depreciating natural resource stocks (natural capital) along the same lines currently used for human-made capital (*e.g.*, buildings, machinery and equipment) is underway. This will allow the production of a net national product (NNP) figure for economic performance that more adequately accounts for all of the cost to society of production.

Tables 4.1 and 4.2 provide a detailed description of the main components of the extended Input-Output model (Figure 4.4). The cell indicated by **A** lists the components of the land-related economy, while **B** shows the same type of information for the ocean-related sector. When all industries (the sum of A and B) are taken together in cell **C**, they mirror both the structure of the existing I/O model and the modifications that have been made in this study. Thus A - C describes the structure of the inter-industry matrix. The primary input structure is shown in cell **D** and lists the main category of payments made for inputs. The final demand components are shown in **E** and constitute the expenditures made for the output of the economy. They represent the broadly defined components of PEI's Gross Domestic Product, and the two principal ways that GDP was calculated.

The extended Input-Output accounts will assist us in understanding the impact of changes in economic structure on both the economy and the environment. The extended accounts will provide a set of useful indicators that illustrate the extent of natural resource (source) extraction and provision of environmental services (waste sink). However, this data is based on physical quantities which are not conducive to cost-benefit analysis. An extended cost-benefit analysis involves determining the value of the non-market costs and benefits in the various contexts in which this type of analysis is used.

Figure 4.4: An Extended Input-Output Model for PEI

Outputs INDUSTRIES Inputs	Land (1)	Ocean (2)	Subtotal (3) = (1) + (2)	Final Demand (4)	Total (5) = (3) + (4)	Waste Discharge to Environment (6)
Land (1)	A					
Ocean (2)		B				
Subtotal (3) = (1) + (2)			C	E		
Inputs (4)			D			
Total (5) = (3) + (4)						G
Environmental Resource Commodities (6)					F	▨

A = land related inter-industry transactions matrix
B = ocean-related inter-industry transaction matrix
C = total economy's inter-industry transaction matrix
D = inputs of productive factors (land, labour and capital) to industry
E = final demand for goods and services produced by industry for consumption, investment, government and net exports
F = satellite account (*i.e.* linked to the main I/O model from outside) for the total environmental resource commodities provided to industry and final demand. This is the stock of resources and their annual flow to the economy (row total)
G = satellite account (*i.e.* linked to the main I/O model from outside) for total waste discharges to the environment from industry (column total)

Table 4.1: A Hypothetical, Resource / Environmental Input-Output Model for PEI: Inter-industry Transaction Matrix Sectors

A. LAND-RELATED

Primary Industries

1. Agriculture
2. Hunting and trapping
3. Forestry
4. Mining, quarrying and oil extraction

Manufacturing (primary)

5. Agricultural food processing
6. Other land-related primary manufacturing

Manufacturing

7. General construction
8. General materials fabrication
9. Other land-related manufacturing

Services

10. General transportation and storage
11. Electric power, gas and other utilities
12. Wholesale trade
13. Retail trade
14. Finance, insurance and real estate
15. Community, business and personal services
16. Government
17. Other land-related services

B. OCEAN-RELATED

Primary Industries

1. Traditional fishing
2. Aquaculture

Manufacturing (primary)

3. Fish processing
4. Other ocean-related primary manufacture

Manufacturing

5. Marine construction
6. Ship building and boatbuilding
7. Marine technology
8. Other ocean-related manufacture

Services

9. Ferry services
10. Ports
11. Research and other services
12. Marine-related tourism
13. Government
14. Other ocean-related services

C. ALL INDUSTRIES

Primary

1. Agriculture
2. Traditional fishing
3. Aquaculture
4. Hunting and trapping
5. Forestry
6. Mining, quarrying and oil extraction

Manufacturing (primary)

7. Agricultural food processing
8. Fish processing
9. Other primary manufacturing

Manufacturing

10. General construction
11. Marine construction
12. General materials fabrication
13. Ship and boatbuilding
14. Marine technology
15. Other manufacturing

Services

16. General transportation and storage
17. Ferry services
18. Ports
19. Electric power, gas and other utilities
20. Wholesale trade
21. Retail trade
22. Finance, insurance and real estate
23. Community, business and personal services
24. Research and other services
25. Marine-related tourism
26. Government
27. Other services

Table 4.2: A Hypothetical, Resource / Environmental Input-Output Model for PEI: Primary Input and Final Demand Components

D. PRIMARY INPUTS
1. Gross inventory depletion (-)
2. Capital depreciation allowances
3. Payments to government
4. Imports from other Canadian provinces or territories
5. Imports from regions outside of Canada
6. Payments to households

E. FINAL DEMAND COMPONENTS
1. Gross inventory accumulations (+)
2. Investment
3. Government purchases
4. Exports to other Canadian provinces or territories
5. Exports to regions outside Canada
6. Purchases by households

Table 4.3 is more hypothetical, since it makes use of the components of resource/environmental commodities (**F**) and the waste discharges to the environment (**G**) that are part of the Canadian System of Environmental and Resource Accounts. A study of the specific resource and environmental systems that are linked to the PEI economy is needed to properly structure these satellite accounts. This table, however, provides some examples of the type of information that would be needed in satellite accounts specifically designed for PEI.

As was pointed out in the last section, the satellite accounts, although not in monetary terms, can be very valuable in providing the biophysical data needed to determine the economic value of environmental resources.

Table 4.3: A Hypothetical, Resource / Environmental Input-Output Model for PEI: Resource and Environmental Satellite Accounts

F. RESOURCE/ENVIRONMENTAL COMMODITIES

1. Soil
2. Sub-soil resources
    - 2.1 Crude petroleum
    - 2.2 Natural gas
    - 2.3 Natural gas liquids
    - 2.4 Coal
    - 2.5 Metals
    - 2.6 Non-metals
        - 2.6.1 Nitrogen
        - 2.6.2 Phosphorus
        - 2.6.3 Potassium
        - 2.6.4 Sulphur
        - 2.6.5 Chlorine and halogens
        - 2.6.6 Other non-metals
    - 2.7 Non-metallic minerals
        - 2.7.1 Salt
        - 2.7.2 Potash
        - 2.7.3 Limestone
        - 2.7.4 Sand and gravel
        - 2.7.5 Gypsum
        - 2.7.6 Other non-metallic minerals
3. Bio-resources
    - 3.1 Wood
    - 3.2 Marine resources
        - ▪ pelagic fish
        - ▪ groundfish
        - ▪ crustaceans and molluscs
        - ▪ other marine resources
    - 3.3 Terrestrial flora and fauna
4. Water
5. Energy
6. Recycled wastes
    - 6.1 Recycled ferrous metals
    - 6.2 Recycled aluminium
    - 6.3 Other recycled non-ferrous metals
    - 6.4 Recycled water
    - 6.5 Recycled wood fibre

G. WASTE DISCHARGES TO THE ENVIRONMENT

1. Organic compounds and materials
    - 1.1 Petrochemicals and feedstocks
    - 1.2 Pesticides
    - 1.3 Halogenated compounds
        - 1.3.1 Dioxins and furans
        - 1.3.2 Chlorofluorocarbons
        - 1.3.3 Others
    - 1.1 Plastics
    - 1.2 Rubber
    - 1.3 Grease and oil
    - 1.4 Bio-source materials
    - 1.5 Organic mixtures and composites
2. Inorganic compounds and materials
    - 2.1 Halogens and their compounds
    - 2.2 Ferrous metals and their compounds
    - 2.3 Non-ferrous metals and their compounds
        - 2.3.1 Non-radioactive
        - 2.3.2 Radioactive
    - 2.4 Oxides of carbon, nitrogen and sulphur
    - 2.5 Mineral acids
    - 2.6 Nitrates, phosphates and sulphates
    - 2.7 Synthetic fertilisers
    - 2.8 Minerals and mineral-based materials
        - 2.8.1 Asbestos
        - 2.8.2 Glass
        - 2.8.3 Others
    - 2.9 Particulate matter
    - 2.10 Soil
    - 2.11 Inorganic mixtures and composites nes.
3. Durable goods
    - 3.1 Transportation equipment
    - 3.2 Machinery and appliances
    - 3.3 Furnishings
    - 3.4 Mixed demolition waste
    - 3.5 Other durable-good wastes
4. Waste energy
    - 4.1 Heat
    - 4.2 Light
    - 4.3 Noise

4.7 Measuring the Non-market Values

In order to move from the important biophysical information in the accounts described in section 4.6 to an economic value for non-marketed resources and environmental services, it is necessary to develop ways of estimating their value. Because they are not traded in markets, they are not valued in the same way as commercial resources. Prices are taken to be zero. This, however, is a false reading of the real value to society, so ways to assign a value must be found to reflect their importance.

This information is very important for project/program planning and evaluation, analysis of policy impacts, and the development of performance indicators that provide broader and more accurate measures of economic and social 'well-being', such as *green* GDP accounts for PEI. The extended I/O accounts provide an essential database from which improvements can be developed. Transforming information in physical quantities to economic values in dollar terms requires the application of a variety of measurement techniques that are both varied and technical. Appendix G provides a more detailed explanation of this type of measurement[29]. With the appropriate assumptions the value of non-market ocean resources can be assessed.

In order to provide some sense of the economic value of non-market ecosystem services, the results of a valuation exercise conducted by 13 specialists lead by Robert Costanza can be reviewed[30]. Their study determined that while global GDP was then about $18 trillion US dollars, the value of global ecosystem services and natural capital (conservatively estimated) was on average 33 trillion US dollars.

The study by Costanza *et. al*. estimated the economic value of 17 ecosystems for 16 biomes. Table 4.4 provides a breakdown of the estimated average global values for both marine and terrestrial biomes. Marine biomes accounted for 63% of the value and terrestrial biomes accounted for 37%.

The exercise was as much one of environmental politics as hard science, but it makes a point about the importance of nature. Because of the acknowledged methodological weaknesses, the Costanza study was intended to spur debate and not be used for further extrapolations and specific valuations. However, when conducting future studies in PEI, the Costanza *et. al.* study will provide guidance regarding the importance of integrating environment and economy and in approaches to many difficult areas of valuation.

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[29] The bibliography provides references to several very useful studies that document approaches to economic valuation. See Dixon, Scura, Carpenter and Sherman (1994); OECD (1995); Pearce (1993); Statistics Canada (1997); and United Nations (2000).

[30] See Costanza *et. al*. (1997).

Table 4.4: Estimated Average Global Values of Annual Ecosystem Services

Biome	Area (million hectares)	%	Value ($ billion US)	%
MARINE	**36,302**	**64.0%**	**$20,949**	**62.9%**
Open Ocean	33,200		8,831	
Coastal	3,102		12,568	
Estuaries	180		4,110	
▪ sea grass/algae beds	200		3,800	
▪ coral reefs	62		375	
▪ continental shelves	2,660			
TERRESTRIAL	**15,323**	**36.0%**	**$12,319**	**37.1%**
Forest	4,855		4,706	
Grass/range lands	3,898		906	
Wetlands	330		4,879	
Lakes/rivers	200		1,700	
Deserts and tundra	2,668		-	
Ice/rock	1,640		-	
Cropland	1,400		-	
Urban	332		128	
TOTAL	**51,625**	**100%**	**$33,269**	**100%**

Source: Costanza, *et.al.* (1997)

Chapter Five
Conclusions and Recommendations

This study has used economic impact assessment techniques to estimate the importance of the ocean sector to the economy of Prince Edward Island. However, to provide a more realistic assessment of the value of the ocean sector, it will be necessary to refine data collection and estimation techniques to include activities that are currently left out due to difficulties in obtaining data, and to incorporate the principles of environmental economics.

The evident conclusion from this work is that the ocean sector is a very important contributor to PEI's economy, whether measured in terms of GDP, household income, or employment. It should be appreciated, however, that economic activities, indeed entire economies, are dynamic and subject to change, often in response to external shocks. The ocean sector is particularly vulnerable in this respect, subject as it is to both natural and market forces.

The private industries that either depend on the ocean as a resource or use it as a medium of movement or operation are quite diverse. Fish-related industries are the most important, whether traditional fishing, fish processing or aquaculture. Tourism and transportation are also important. A variety of smaller industries are significant, including ports, ocean-related construction, boatbuilding, ocean-related research, and ocean-related technology and manufacturing. Although quite small, some of these industries offer great potential for growth.

Management of important ocean resources demands government involvement, both to ensure that industries that depend on them can be sustained, and also that natural systems upon which they are based can be conserved. Federal and provincial departments all have roles to play. Cooperation among departments is essential to reduce or eliminate duplication of effort.

The need to move to some form of new development paradigm is now very apparent. Economic systems are shifting to knowledge-based enterprises, often by the development of industry clusters and institutions (universities, governments, etc.) which have close linkages between the components of a cluster. In this way, innovation-driven economic and industrial development is catalyzed and, at critical mass, can become a potent tool for economic development. An innovation cluster that is centred on ocean resources in PEI deserves further investigation.

The fact that this study has been primarily a 'traditional' economic accounting exercise also deserves further attention. Economic growth is not without cost, but in many cases these costs are not reflected (paid for) in markets; they are present, however, in terms of pollution, environmental degradation and loss of habitat. Also, there is frequently a social cost involved, measured by loss of community. For example, if a commercial fish stock collapses, the jobs and incomes derived from catching or processing the fish disappear. Canada, and Atlantic Canada in particular, should develop and implement an accounting methodology which integrates economics, the environment and societal issues.

This can be accomplished by the adoption of a systems approach and the creation of extended Input-Output accounts which will serve to:

- integrate environment and economy (both marine and terrestrial) within a single analytical framework;
- create a database necessary for a full cost accounting of economic development; and
- provide an improved analytical framework that facilitates planning and decision-making for sustainable development.

Several steps will be required to create the extended I/O framework, including:

- the assembly and review of all available information about the Island's natural resource base and the determination of necessary further studies;
- the design of an extended I/O model that fully reflects the environment-economy interactions in PEI; and
- the collection and presentation of quantitative information that describes resource stocks and flows, and waste flows.

Since the information from the expanded I/O accounts is needed for policy purposes, attention must be given to information usage in order to:

- develop indicators of environmental and resource efficiency based on the resource and environmental waste database;
- consider the economic value of environmental assets and services for the purpose of developing adjustments to provincial GDP that fully reflect the cost of economic development; and
- experiment with broader approaches to project/program appraisal and evaluation to promote better decision-making.

For Prince Edward Island to maintain and sustain economic progress in the ocean sector will require constant attention to the development of new markets and new products. In addition, it will require the reconciliation of environment and economics in the management of resources, and for the protection of the environment on which they depend - the ocean.

APPENDIX A

Summary of Data Quality, Data Sources and Standard Industrial Classification Codes

APPENDIX A

Summary of Data Quality, Data Sources and Standard Industrial Classification Codes

The study team has endeavoured to make the data and methods of estimation as transparent as possible. Where data were judged to be less reliable or difficult to obtain, it was noted.

Traditional Fishing

The value of landings and direct employment was provided by the Department of Fisheries and Oceans. The Department reports fishers on a full-time (core) and part-time (non-core) basis. The reported results for 1999 showed full-time employment at 1,352 persons and part-time at 3,385. Data on the conversion of part-time to full-time equivalent were not available. A conversion factor of 4:1 was utilized and considered to be appropriate based on previous discussions with federal and provincial fisheries personnel in relation to the Nova Scotia and New Brunswick coastal/ocean-related studies. The ratio of 4:1 was also used to ensure consistency with the previous studies. This is a departure from the standard 1.6 to 1 ratio. Application of the 4:1 ratio resulted in an estimated full-time equivalent of 2,198 in 1999.

Direct payroll was calculated as 0.4837 of landed value (PEI I/O Direct Requirements). The calculated average (1997-1999) fishing income was $58.8 million. Recreational fishing was not included in the study to avoid double counting. The major economic impact of recreational saltwater fishing would have come from off-island anglers. These tourists were captured in the Ocean-related Tourism section of the study.

Local anglers were not included in the study due to the lack of data for the study period and the fact that the expenditures are on-island discretionary dollars which would probably be spent elsewhere if fishing was not available, hence producing a small net (+/-) economic impact.

Aquaculture

Aquaculture sales data were taken directly from Statistics Canada publications #21-603, *Agriculture Economic Statistics* and #26-603, *Agriculture Economic Statistics - Updates*. The sales data were comprised primarily of mussel production which accounted for almost 85% of the output. Mussels and oysters represented the bulk of aquaculture production in PEI.

Complete data on employment and payroll for the aquaculture sector were difficult to obtain. Again, key data was extracted from Statistics Canada publications #21-603 and #26-603. Officials of the PEI Department of Fisheries, Aquaculture and Environment and industry personnel also provided data.

Fish Processing

The value of shipments for fish processing was taken from Statistics Canada's *Manufacturing Industries of Canada: National and Provincial Area,* catalogue #31-203. The values are 'at the factory gate', *i.e.* exclusive of transportation margins.

The payroll and employment data were the total activity employment and payroll as reported in Statistics Canada's catalogue #31-203; it included administrative, office and other non-production employment, and production employment. Data for 1999 were estimated using 1998 ratios of employment and payroll to shipments. Shipments for 1999 were obtained from publication #31-001 (Table 10) and data from the PEI Department of the Provincial Treasury publication *Statistical Review 2000.*

Initially fish processing exports were obtained from Industry Canada/Statistics Canada. As reported, these exports (55-60% of output) appeared low according to PEI provincial officials and industry representatives. Fish processing exports were accordingly adjusted by Canmac Economics to reflect this advice.

Data from the Statistics Canada Trade Division also placed fish processing exports in the 55-60% range for the study period. However, these numbers were only international exports and the adjustment accounted for 'quasi' inter-provincial exports and suspected under coverage. Three Statistics Canada publications address this issue in more detail: *Pitfalls in the Use of International Merchandise Trade*; *Intransit*; and *Examination of U.S./Canada In-transit Trade Issues*. These are undated references and were provided by the International Trade Division of Statistics Canada.

Lobster was the primary processed export from PEI. Discussion with industry members and officials with the PEI Department of Fisheries, Aquaculture and Environment revealed exports were between 90% and 95% of production over the study period. However, the exports were conservatively adjusted to 90% of fish processing production.

Shipbuilding and Boatbuilding

Data for shipbuilding and boatbuilding shipments were developed from two sources. Boatbuilding and shipbuilding shipment data were available for 1997 and 1998 from Statistics Canada #31-203. Production for 1999 was estimated by Canmac Economics Ltd primarily using monthly shipment data from Statistics Canada #31-001, Table 10. However, the monthly data only provided production figures; hence, the 1999 employment and payroll was estimated using the ratios of employment and payroll to shipments from 1998 data.

As with fish processing, initial exports were obtained from Industry Canada/Statistics Canada. These data only captured 'international' exports (a small market for PEI), and did not report 'inter-provincial' exports, the main off-island market. Exports were adjusted to 50% of sales as per the recent ACOA study, *A Profile of the PEI Boat Manufacturing Industry* [31].

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[31] ACOA (2001).

Marine Technology Manufacturing

Sales, employment and direct payroll data were difficult to acquire for marine technology manufacturing. Because of its small size, data is not recorded by Statistics Canada. A list of ocean technology manufacturing firms was obtained from a database prepared for the Department of Fisheries and Oceans, *Canada's Ocean Industries: Contribution to the Economy 1988-1996* (1998) and from the *Online Business Directory* (2001) and the *Directory of Manufacturing and Processors* (2000). Discussions with government officials were also a source of information. Personnel from the companies listed were surveyed (80% interviewed in person, 20% by phone survey). Data were collected for the key indicators but, due to the reluctance of some interviewees with respect to sales data, a range was provided and the average used.

Marine Transportation

Output, employment and payroll data were not available in published form for ferry services or for the Confederation Bridge. Data were derived indirectly. Northumberland Ferries and CTMA Group provided data on total operation costs; this was used as a measure of output, employment and payroll for the period 1997-1999.

Data for the Confederation Bridge were much more difficult to obtain. Direct discussions resulted in only employment data being made available and therefore secondary sources were used. Sales estimates were developed using toll information from Strait Crossings and traffic estimates from the *PEI Statistical Review 2000*. The payroll was estimated using the actual employment numbers and a calculated average wage[32].

Marine Construction Services

Output data were available in published form for marine construction activity in Statistics Canada's *Capital Expenditure by Type of Asset*, catalogue #61-223. Employment levels and payroll were estimated by applying the ratios of payroll to total construction available in the Input-Output model (Direct Requirements) and by applying the PEI average construction wage to the payroll data.

Ports and Harbours

Cargo movement was used as a proxy measure for port output. Cargo movement data were available in published form from Statistics Canada publication #54-205. Payroll data for the ports were obtained from a study by the Prince Edward Island Ports Study Group (1999). To estimate the level of employment, the transportation average annual wage was applied to the payroll data. The ratio (1999) of payroll and employment to cargo was used to estimate payroll and employment for 1996-1998.

Ocean-related Research and Other Services

Sales, employment and payroll data for the research and other services were provided by direct interviews and a study undertaken for the Atlantic Veterinary College (AVC) by the Atlantic Provinces Economic Council (2000). The commercial/research wing of the Atlantic Veterinary College is AVC Inc. Data were readily available for AVC as a whole but had to be manipulated to capture the ocean-related research services. From the APEC study it was ascertained that approximately 34% of AVC research funding was directed to ocean-related activities. This percentage was applied to data obtained through personal interviews to allocate the ocean-related activity of AVC and AVC Inc.

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[32] See Gardner Pinfold Consulting Economists Ltd (1993).

Other research organizations on the Island such as UPEI, the PEI Food Technology Centre, the National Research Council and private enterprise were also contacted to obtain data on their respective ocean-related expenditures, employment and payroll.

Ocean-related Tourism

Data on ocean-related tourism were not directly available, hence indirect methods were used to estimate output, employment and payroll. The 1999 annual tourism exit survey data were utilized to identify the reasons which tourists cited for visiting PEI. From this data it was calculated that approximately 35% of tourists cited an ocean-related activity as the primary reason for visiting PEI. This does not infer that 65% did not participate in an ocean-related activity; over 60% did go to the beach, participate in lobster suppers, bird watching, etc., but this was not stated as their primary reason for visiting PEI. The income associated with the ocean-related tourism expenditures was estimated using the Input-Output model direct requirements for travel and accommodations service. Full-time equivalent employment was calculated using the PEI average annual wage for the service industry.

PEI Department of Fisheries, Aquaculture and Environment

Expenditures, employment and payroll data were provided by the Department.

Tourism PEI

Data on ocean-related activity were derived from annual reports and personal interviews with Tourism PEI officials. The ocean-related allocation of departmental activity was not readily available as all spending is generic, with the exception of targeted campaigns such as Golf Links PEI. To allocate ocean-related activities, the same methodology was followed as with tourist activity. Using the tourism exit surveys, departmental activity was apportioned based on the percentage of tourists citing an ocean-related activity as the primary reason for visiting PEI.

Department of Fisheries and Oceans

The expenditures, employment and payroll data were for DFO activities within Prince Edward Island and were based on direct estimates from both the DFO Gulf Region and the Maritimes Region, Financial Planning and Analysis Division.

Environment Canada

Expenditures, employment and payroll data were estimated based on written information and interviews with personnel from the Island office of Environment Canada.

Parks Canada

Expenditures, employment and payroll data were provided by personnel from the Parks Canada office in Charlottetown. Employment data were provided as full-time, seasonal and student employment. Full-time equivalent employment was calculated using a 2:1 ratio for seasonal employment and a 4:1 ratio for student employment.

Standard Industrial Classification (SIC)

The Standard Industrial Classification (SIC) associated with each Industry/Sector included in the study is noted below. These SIC numbers are based on the Statistics Canada 1980 SIC codes which are available in publication #12-501E. Since 1998/1999 Canada, Mexico and the United States have converted to the North American Industrial Classification System (NAICS). Concordance tables (available from Statistics Canada) will be required for future projects designed to replicate this study.

Industry	Title	SIC	Note
Traditional Fishery	Saltwater Fishing Industry	0311	
Aquaculture	N/A	N/A	
Fish Processing	Fish Products Industry	1021	
Shipbuilding	Shipbuilding and Repair Industry	3271	Grouped with 3281
Boatbuilding	Boatbuilding and Repair Industry	3281	Grouped with 3271
Marine Technology	This section encompasses a variety of SICs. Below are the major groups (2 digit SIC) which could fall into this sector and appropriate 4 digit SIC sub-group.		

Industry	Title	SIC	Note
Marine Technology	**Fabricated Metal Products**	**30**	
	Power Boiler and Heat Exchanger Industry	3011	
	Metal Tanks (Heavy Gauge) Industry	3021	
	Plate Work Industry	3022	
	Other Fabricated Structural Metal Products Industry	3029	
	Custom Coating of Metal Products Industry	3041	
	Metal Closure and Container Industry	3042	
	Other Stamped and Pressed Metal Products Industries	3049	
	Wire and Wire Rope Industry	3052	
	Other Wire Products Industries	3059	
	Basic Hardware Industry	306[illegible]	
	Hand Tool and Implement Industry	3063	
	Other Hardware and Cutlery Industries	3069	
	Machine Shop Industry	3081	
	Metal Valve Industry	3092	
	Other Metal Fabricating Industries n.e.c.	3099	

Industry	Title	SIC	Note
Marine Technology *(continued)*	**Machinery Industry**	**31**	
	Commercial Refrigeration and Air Conditioning Equipment Industry	3121	
	Compressor, Pump, and Industrial Fan Industry	3191	
	Turbine and Mechanical Power Transmission Equipment Industry	3194	
	Other Machinery and Equipment Industries n.e.c.	3199	
	Transportation Equipment Industry	**32**	
	Other Transportation Equipment Industries	3299	
	Electrical and Electronic Products Industries	**33**	
	Telecommunication Equipment Industry	3351	
	Electronic Parts and Components Industry	3352	
	Other Communication and Electronic Equipment Industries	3359	
	Electrical Transformer Industry	3371	
	Electrical Switchgear and Protective Equipment Industry	3372	
	Other Electrical Industrial Equipment Industries	3379	
	Communications and Energy Wire and Cable Industry	3381	
	Battery Industry	3391	
	Non-Current Carrying Wiring Devices Industries	3392	
	Other Electrical Products Industries n.e.c.	3399	
	Chemical and Chemical Products Industries	**37**	
	Plastic and Synthetic Resin Industry	3731	
	Paint and Varnish Industry	3751	
	Soap and Cleaning Compounds Industry	3761	
	Other Chemical Products Industries n.e.c.	3799	
	Other Manufacturing Industries	**39**	
	Indicating, Recording and Controlling Instruments Industry	3911	
	Other Instruments and Related Products Industry	3912	
	Other Manufactured Products Industries n.e.c.	3999	

Industry	Title	SIC	Note
Marine-based Service Transport	Ferry Industry	4542	
	Highway, Street and Bridge Maintenance Industry	4591	Bridge only
Marine Construction	Other Industrial Construction	4119	
	Other Heavy Construction	4129	
Port Harbours	Harbour and Port Operations Industry	4552	
Research and Other Services	Computer Services	7721	
	Management Consulting Services	7771	
	Other Business Services	7799	
	Research Administration (Federal)	8176	
	Research Administration	8276	
	Other Educational Services	8599	
Tourism	Hotels and Motor Hotels	9111	
	Motels	9112	
	Tourist Courts and Cabins	9113	
	Guest Houses and Tourist Homes	9114	
	Restaurants, Licensed	9211	
	Restaurants, Unlicensed (including Drive-ins)	9212	
	Take-out Food Services	9213	
	Caterers	9214	
	Boat and Rentals and Marinas	9654	
Public Administration	Federal Various	81XX	
	Provincial Various	82XX	

APPENDIX B

The PEI Input-Output (I/O) Model

APPENDIX B

The PEI Input-Output (I/O) Model

Inter-industry (Input-Output) analysis was developed by the economist Wassily Leontief during the 1930s. It is an empirical representation of a general theory of production based on the notion of economic interdependence. Leontief's original Input-Output (I/O) table showed how each sector of the economy depends upon every other sector (including households), either to supply its inputs or to purchase its outputs. This is still the basic characteristic of all I/O models.

For this study, simulations were conducted with the latest Canmac Prince Edward Island I/O Model to measure the direct, indirect and induced effects associated with the PEI ocean sector.

In an I/O model each industry in the local economy depends, in principle, on every other industry for the supply of intermediate goods. The ultimate goal of the I/O model is to trace the transmission of demand through the economy. The model's operations are, however, somewhat restricted. Firstly, industry production functions are linear and inputs must be used in fixed proportions. In other words, economies and diseconomies of scale are not permitted, as they would require intricate calculation of non-linear functions representing complex and rapidly changing relationships between industries. Secondly, a generally strict assumption of I/O models is that prices and wages are fixed and the supply of both intermediate goods and final goods is unlimited. Thirdly, I/O models take a long time to construct, and may reflect economic relationships that are slightly out-of-date when they are applied.

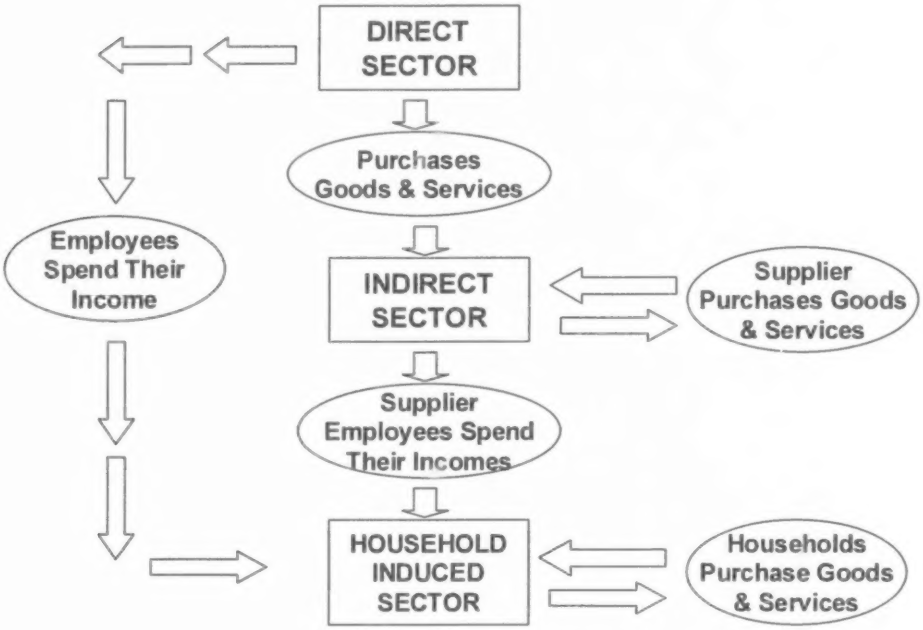
Today, I/O tables are available for about forty national economies and the number of regional and local I/O tables is growing rapidly. The development of computers and efficient methods of calculation permit a great deal of industrial disaggregation, providing considerable details on the economic transactions within an economy, and offering some understanding of how demand moves throughout the economy. This is often simulated as a 'shock', say a 10% or 20% increase or drop in demand.

The I/O model describes impacts in terms of direct, indirect and induced effects. In this study, the direct effect is defined as the total value of output for the specified ocean-related activity (based on the data explained in Chapter Two of this report). The indirect effect is defined as the total value of output from other industries in PEI that supply the ocean sector. This supply includes 'suppliers of suppliers', that is the demand for goods and services includes both direct suppliers to the ocean sector, and to its suppliers. The induced effect refers to the additional industry output that arises as households spend the incomes they earn in the ocean sector, or in supplying inputs to the ocean sector (that is, at the direct and indirect stages). The total economic value of PEI's ocean sector is measured as the sum of the direct, indirect and induced sales. This process is outlined in Figure B.1 on the following page.

Atlantic Canada has an enviable record in the use and production of regional I/O models. The pioneering work of Kari Levitt resulted in Atlantic Canada having some of the first region-specific and province-specific I/O models in Canada or in North America. Prince Edward

Island's I/O tables were updated in 1974, 1979 and again in 1989. Updating such massive tables is a major undertaking. The latest I/O model is supported and actively used for policy analysis by the PEI Department of the Provincial Treasury.

Figure B.1: Economic Impact Process


DIRECT SECTOR
Purchases Goods & Services
Employees Spend Their Income
INDIRECT SECTOR
Supplier Purchases Goods & Services
Supplier Employees Spend Their Incomes
HOUSEHOLD INDUCED SECTOR
Households Purchase Goods & Services

Source: Canmac Economic Ltd

APPENDIX C

PEI Input-Output (I/O) Multipliers

APPENDIX C

PEI Input-Output (I/O) Multipliers

The multipliers used in relation to the Gross Domestic Product (GDP) and household income calculations are listed in Table C.1. These multipliers were developed by Canmac Economics Limited as an update to the 1990 Statistics Canada Input-Output (I/O) multipliers, the latest available from Statistics Canada. The multipliers were developed for use in Canmac's in-house Prince Edward Island I/O Model.

The multipliers are applied to output (sales/expenditure) data to estimate direct and total (direct + indirect + induced) GDP and total (direct + indirect + induced) household income. Direct household income and employment are collected as key economic indicators. Total full-time equivalent employment is calculated by dividing the total household income impact by the PEI average annual wage of $26,584.

Table C.1
PEI Input-Output (I/O) Multipliers

	Direct GDP Coefficient	Total GDP Multiplier	Total Household Income Multiplier
Private			
Traditional Fishery	0.4770	0.6579	0.5937
Aquaculture	0.4362	0.6579	0.3656
Fish Processing	0.2557	0.7871	0.5721
Shipbuilding and Boatbuilding	0.3458	0.5353	0.4627
Marine Technology Manufacturing	0.4083	0.7374	0.4787
Marine Transportation	0.4731	0.5847	0.2056
Marine Construction Services	0.6000	0.8669	0.7128
Ports and Harbours	0.4986	0.8417	0.7444
Research and Other Services	0.7938	0.8810	0.4643
Ocean-related Tourism	0.5572	0.8329	0.5369
Government			
PEI Department of Fisheries, Aquaculture and Environment	0.4261	0.5927	0.5445
Tourism PEI	0.2798	0.3891	0.3886
Department of Fisheries and Oceans	0.5600	0.7789	0.6740
Environment Canada	0.4886	0.6796	0.6050
Parks Canada	0.6324	0.8796	0.7442

APPENDIX D

Non-market Ocean Functions

APPENDIX D

Non-market Ocean Functions

The following are five examples of the ways that non-marketed ocean functions may provide economic value for PEI. They include: (1) global materials cycling, (2) transformation, detoxification and sequestration (storage) of pollutants, and societal wastes, (3) support of the ocean and coastal recreation, tourism and retirement industries, (4) coastal land development and valuation, and (5) provision of cultural and future scientific values[33].

Global Materials Cycling

"The earth's biosphere is affected by and dependent on the large-scale global geochemical processes that cycle the materials necessary for life itself. The terrestrial biosphere is connected to the land, the atmosphere, and the sea through fundamental processes that move and transform elements"[34]. Thus, the interdependent nature of the land, atmosphere and sea cannot be ignored. While there are many natural disruptions to global geochemical processes, the impacts of human activities on carbon and the carbon cycle are of particular concern. Ocean systems are particularly important in this regard, since in the absence of life in the sea, the partitioning of carbon among rock, the atmosphere and ocean waters would be dramatically altered. Were it to happen, through human destruction of large elements of the ocean ecosystem, then the releases of greenhouse gases such as CO_2 would flow in greater volume to the atmosphere. This in turn implies dramatic variations in global temperatures, changes in rainfall and land productivity, sea level rise and coastal flooding. PEI, a province surrounded by and dependent upon the ocean, has a clear stake in doing its part to protect this non-market function of nature upon which its current and future livelihood depends.

Transformation, Detoxification and Sequestration of Wastes

Oceans are used directly and indirectly as a repository, or sink, for unwanted materials from human activity. Dumping of waste directly into national territorial waters is banned in most countries, but this is often poorly monitored and enforced. Indirect depositions of waste take place in oceans through releases on land, into waterways and into the air. Aquatic ecosystems are able to neutralize some negative effects through transformation, detoxification or sequestration.

Transformation occurs, for example, when municipal wastewater sewage systems load aquatic ecosystems with large quantities of inorganic nutrients, such as nitrogen and phosphorous. Deposition of nitrogenous nutrients generated from fossil fuel combustion also occurs in coastal and marine waters from acid rain. The act of transforming this waste to a harmless state (*e.g.*, enhanced phytoplankton production) is a valuable service of nature.

However, if the loading of nutrients exceeds assimilative capacity, damaging eutrophication may occur. This may lead to a loss of ecosystem services as a consequence of oxygen depletion and the growth of nuisance algal blooms. Some of the algal blooms can be toxic for other marine life (*e.g.*, red tide). Wild fish kills and disruptions to aquaculture can be costly for ocean industries.

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[33] The author relies in this section on two chapters from Daily (1997) by Peterson and Lubchenco and by Kaufman and Dayton.

[34] See Peterson and Lubchenco (1997), p. 178.

Natural functioning marine ecosystems are in some cases able to detoxify wastes. An example of this service of nature can be found in the way component compounds of petroleum that carry important health risks for humans are rendered harmless. This occurs when petroleum wastes that work there way into water systems (*e.g.*, through spills or leakage from motors) are deposited on the floor of an estuary or ocean, and naturally occurring microbes detoxify the harmful compounds, mainly by degrading them into carbon dioxide and water.

Other toxic waste, *e.g.*, PCBs, may not be so readily degraded and transformed by ocean ecosystems. In varying degrees, estuarine and marine ecosystems can serve to 'store' these substances in sediments so they are biologically unavailable unless physically disturbed.

Ocean Ecosystem's Importance to Tourism, Recreation and Retirement

In addition to the fisheries and aquaculture, tourism is the industry in PEI most obviously tied to ocean ecosystems. Tourism generally represents the non-consumptive uses of natural coastal ecosystems. Tourists visit the Island for numerous reasons, including: sport fishing; bird watching; nature photography; water sports; appreciating local marine and plant life; walking on pristine beaches; and enjoying coastal sunrises and sunsets. These environmental assets are also frequently important in individual choices about a retirement home. There is clearly an economic value derived from tourism, recreation and retirement living that is dependent upon ecosystem integrity and quality, even though those qualities are not currently traded in any market.

Coastal Land Development and Valuation

The quantity and quality of amenities provided by ocean and coastal resource systems is critical to the value of shoreline real estate. In fact congestion in many areas is detracting from the desirability of these areas both because the number of people and their waste degrade the environment and because the shear number of people detracts from the way individuals experience nature. PEI real estate values reflect the quality of the environment.

Cultural and Future Scientific Values

Marine ecosystems have a significant place in PEI's culture. Islanders have always lived with the sea and drawn upon it for a livelihood (fishing), used it for transportation, and pursued aquatic recreational activities. The Island's natural ecosystems are also a repository of scientific information which itself is a natural capital that can, in the future, be used to create wealth and improve the welfare of Islanders. The failure to preserve and value this information bank will represent a depletion of the Island's natural heritage.

APPENDIX E

Moving from a Linear Throughput Model to a Systems Perspective

APPENDIX E

Moving from a Linear Throughput Model to a Systems Perspective

A representation of a genuinely circular economy, the materials balance model, is shown in Figure E.1[35]. It incorporates feedback loops that demonstrate the relationship between economy and environment and the relevance of the first and second Laws of Thermodynamics. The top line, taken alone, represents a linear throughput model where resources (**R**) are extracted from nature, transformed by technical production processes (**P**) and then used by consumers (**C**) who derive satisfaction or utility (**U**) from consumption.

Since energy and matter are neither created nor destroyed in the process of their use (First Law of Thermodynamics), the source of resources and the disbursement of waste must be accounted. Resources (**R**) may be divided into non-renewable resources (**ER**) and renewable resources (**RR**)[36]. These resource concepts include both market and non-market aspects, *i.e.* they also include non-market environmental assets. This diagram also shows that resource use (**R**), production (**P**) and consumption (**C**) all produce waste (**W**). However, the environment provides services to assimilate (**A**) waste. Thus nature can safely process waste up to its assimilative capacity (**A**).

Figure E.1 also shows that the stock of renewable resources (**RR**) can be maintained or even expanded when the rate of harvest (**h**) is less than the yield rate (**y**), *i.e.* $h<y$. If the harvest rate is greater than the yield rate (*i.e.* $h>y$) then the stock of renewable resources is being diminished. With exhaustible resources (**ER**) the problem is a little different, because any use will result in the harvest rate being greater than the yield rate. In other words exhaustible resource stocks will decline and decision makers must determine the appropriate rate at which the stock should be diminished. Use of resources - both renewable and non-renewable - may diminish both the resources of commercial interest as well as the underlying productive capability of nature that has created these resources.

The concept of assimilative capacity (**A**)[37] tells us that if too much waste is put into the environment (**W>A**), it will damage ecological systems that provide the assimilative capacity. The most graphic example is the substances released into the air that destroy the ozone layer and allow damaging radiation to reach the Earth's surface. When waste deposition is less than the assimilative capacity of the environment (*i.e.* $W<A$), the integrity of ecological systems are maintained to continue performing waste assimilation services; a feedback loop shows it expands

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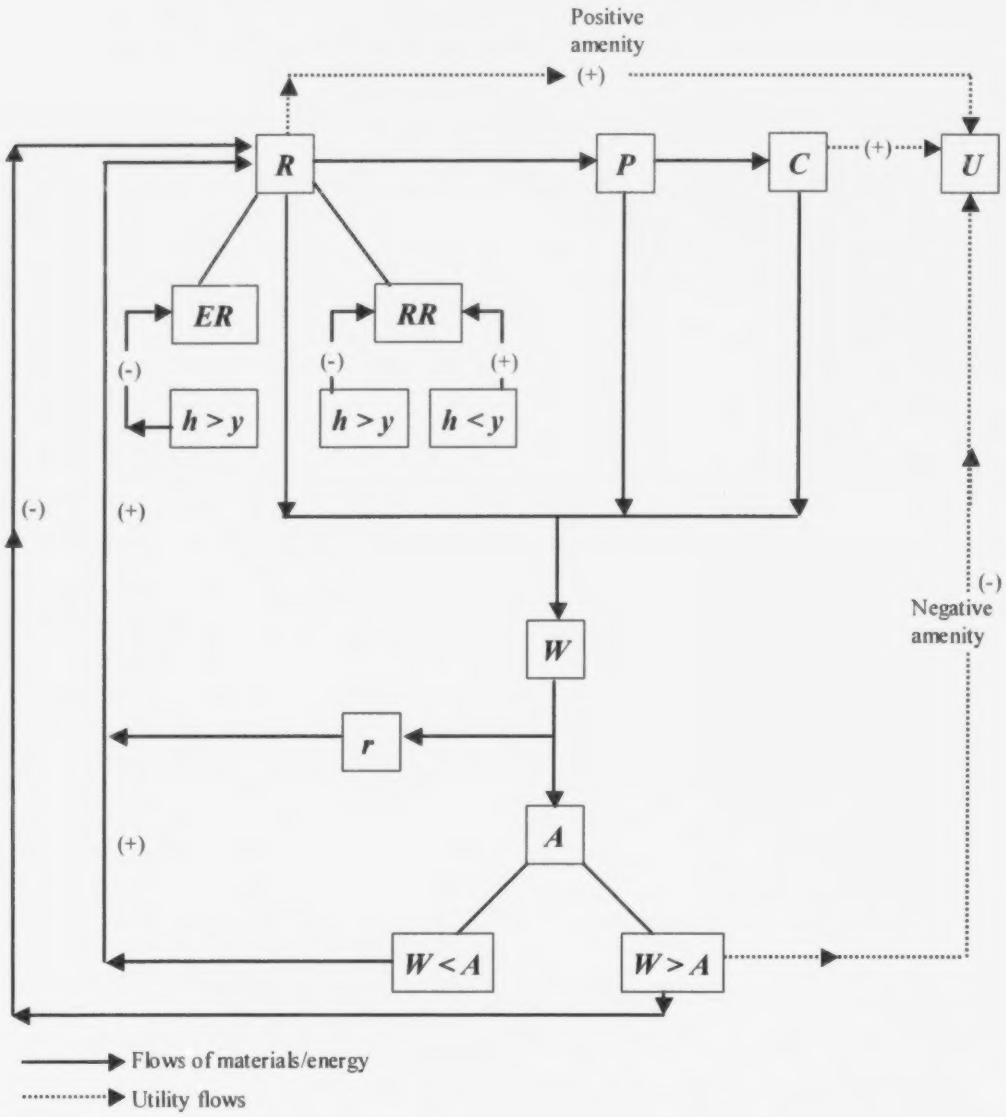
[35] The figure shows how all materials and energy are accounted for within a production system in terms of their stocks and flows and reflects the feedback loops that make it truly circular. This model is in conformance to the Laws of Thermodynamics.

[36] Renewable resources here includes continuous resources as well.

[37] It must be recognized that a single global number for A does not and cannot exist. The relevant ecological systems have a very wide range of scales. Thus the relationship between A and W must be established for each relevant ecosystem.

the resource base (**R**). This means that environmental or ecological services of this type function like a renewable resource.

Figure E.1: The Circular Economy: The Materials Balance Model


Positive amenity
(+)
R
P
C
(+)
U
ER
RR
(-)
h > y
(-)
(+)
h > y
h < y
(-)
(+)
(-)
Negative amenity
W
r
A
(+)
W < A
W > A
Flows of materials/energy
Utility flows

Source: Pearce and Turner 1990:40

The Second Law of Thermodynamics is captured in a resource recycling loop (**r**) such that waste may be recovered in order to perform more useful work. In this sense it adds to the stock of resources. However, the entropy law tells us that we will not be able to capture all of the original energy and materials and some will go to waste (**W**). Finally, there are both positive and negative amenity feedback loops. The resource base (**R**) also provides 'information functions of nature' which in turn provide human populations with satisfaction or utility (**U**). On the other hand, where waste deposition is greater than the assimilative capacity of the environment (*i.e.* W>A), the resulting environmental degradation is registered as a lessening of human satisfaction or utility (**U**).

Thus, this conceptual model transforms the linear throughput model to a systems-oriented representation of the interaction between economy and environment. This approach is needed for future work in order to identify the value and importance of ocean and coastal resources for provincial, regional and national economies. When this perspective is adopted, the interdependence of land and sea becomes very apparent.

APPENDIX F

Extending Input-Output Systems with Environmental and Resource Accounts

APPENDIX F

Extending Input-Output Systems with Environmental and Resource Accounts

As the I/O accounts have been generally configured, they only reflect market related exchange flows between industries. This structure is reflected in Figure F.1 by the core matrix within the heavily lined box. At their most detailed the Canadian I/O accounts include 216 industry groups (**A**), 637 commodity groups (**B**) and 136 categories of final demand (**D**). Since the I/O accounts are aggregated according to a set of Standard Commodity and Industrial Classifications, they demonstrate an economic structure that does not highlight ocean-related industries. The type of research being conducted in this study of PEI seeks to adjust the accounts to reflect an ocean perspective. However, the adjustments have been limited to market transactions.

During the last 10-15 years major strides have been achieved by various countries and international agencies in designing satellite accounts that provide a means of linking market economic information and non-market environmental and resource information. This linkage is reflected in Figure F.1 by the input information about environmental (resource) commodities (**Q**, **R** and **S**), and the output of waste discharge to the environment (**N**, **O** and **P**). These constitute respectively a recognition of the source and sink functions of nature. These satellite accounts, however, are not 'costed' in a single and consistent manner. For example, some are stated in monetary values, but others are in terms of physical weight, volume or energy measures. Nevertheless the satellite accounts allow the study of the linkage between the economic structure and key environmental functions.

Work in this area has been undertaken by the UN, OECD and a number of nations, including: Canada, the Nordic countries, Australia, Germany, the Netherlands and France. Most of this work has been consistent with, and contributed to, the establishment of a UN standard for integrating environmental and economic accounting procedures[38]. However, the full scope and depth of detail in these satellite accounts remain matters that are under development.

Natural Resource Stock Accounts

There are a variety of natural resource stock accounts that have been developed by different countries, often reflecting the resources that are most important to a particular country[39]. These sectors usually include:

- Forest accounts
- Land (soil quality)
- Subsoil assets (minerals)
- Aquatic resources (fisheries)
- Aquatic resources (water supply)

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[38] See UN (2000).

[39] The approach used in Canada is discussed in Statistics Canada (1997), #16-505-GPE, pp.21-66.

Figure F.1: An Extended Input-Output Table with Environmental Commodities

	Commodities	Industries	Final Demand	Total	Waste Discharge to Environment
Commodities		A	D	F	N
Industries	B			G	O
Primary Inputs		C	E	H	
Totals	K	L	M	J	P
Environmental Commodities	Q	R		S	

Source: Pearce and Turner (1990)

These accounts develop a snapshot at a moment in time of the stock of resources, by sector. Each year the difference between the opening stock at the beginning of the year and the closing stock one year later is utilized. This flow, or draw on the stock, in the case of a renewable resource, may not be problematic for the resource system if the amount harvested is less than the sustainable yield. If the harvest rate is more than the sustainable yield, the diminished stock of resources will not be able to produce equally great flows in the future. The natural capital is being diminished.

Material and Energy Flow Accounts

These accounts record, in principle, all of the resources and wastes that cross the environment/ economy boundary. For example, in the Canadian accounts they are related to the activities of 160 industries, plus a wide array of household and government activities. Thus a picture is provided of how economic activities - currently taking place or being proposed - will impact upon the environment. This accounting framework includes components which relate to:

- production and consumption of resources and waste
- waste disposal

The energy accounts are particularly important and have been well developed in a number of countries, including Canada[40].

Environmental Protection Expenditure Accounts

In the Canadian accounting system, these accounts present an annual time-series of current and capital expenditures on environmental protection. They are broken down into three sectoral accounts:

- **household** expenditures on environmental protection
- **government** current and capital expenditures on environmental protection, plus intergovernmental and inter-sectoral government transfer payments; and
- **business** capital and operating expenditures on environmental protection

This account measures the defensive expenditures, *i.e.* those expenditures necessary to protect the environment from degradation. This type of information is important in 'greening' GDP at either the national or provincial level. Doing so involves accounting for all of the costs to society of economic output. Key economic indicators (*e.g.*, GDP) can be modified according to the benefits obtained from economic activity.

All of the accounting methods described above, as difficult as they are to apply at a national level, are now beginning to be applied at the provincial level. In Nova Scotia, GPI Atlantic[41] is creating a variety of estimations of the economic value of the components of a Genuine Progress Index for the Province. In PEI, Environment Canada has initiated a project with the Southeast Environmental Association to evaluate, quantify and monetize injuries or loss of natural resources due to a pollution event using a technique called Environmental Damages Assessment. These methodologies promise to become indispensable tools in the future for sustainable development planning.

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[40] Ibid.

[41] See Colman (1998).

APPENDIX G

Measuring Non-market Values

APPENDIX G

Measuring Non-market Values

Greening GDP, Index of Sustainable Economic Welfare (ISEW), Genuine Progress Index (GPI) and Environmental Indicators

Gross Domestic Product (GDP) is the measure of the economic value of a society's production of goods and services during the year. With only a few exceptions this information reflects what happens in organized markets and the value is reflected in price information. GDP provides a set of very important economic indicators. However, it does not highlight the importance of any particular sector and its components, *e.g.*, those related to the ocean sector. Although highlighting the importance of oceans-related industries through the use of an Input-Output model is the primary objective of this study, GDP does not provide a good indicator of economic and social 'well-being'.

Two examples of anomalous results will demonstrate the weakness of GDP analysis:

First, Indonesia in the 1970's was put forward as a golden example of an Asian economy which had achieved remarkable levels of economic growth. However, analysis of this economic miracle conducted by Reppeto and Gillis[42] revealed that this growth was significantly overstated because it was based on harvesting valuable tropical hardwoods for export at unsustainable rates. In other words, a renewable forest resource was being harvested significantly beyond a sustainable yield. This stock of natural forest capital was being treated as a non-renewable resource and essentially 'mined'. The depletion or degrading of underlying ecological systems were so damaging that future generations would receive a greatly diminished stock of natural capital. When Reppeto and Gillis estimated the value of forest stock depreciation in Indonesia, it became clear that the countries economic growth was less than half the original estimate. Thus the failure to recognize the value of the depleted stock of resources in production lead to a highly misleading indication of how well the Indonesian economy was performing.

Second, when the Exxon Valdez tanker went aground in Alaska in 1989, it caused immense environmental damage by degrading water quality, destroying ecological systems, damaging the fishery, killing large quantities of water fowl and despoiling the scenic coast line. Despite the obviously undesirable impact, the damage actually caused the GDP of Alaska to rise! This was the case because many people were employed in clean-up operations, lots of equipment was rented or purchased, several lawyers were hired to deal with the lawsuits that arose and so on. What is the reason for this anomaly? The value added to the economy of all the clean-up related production was added to GDP without deducting any estimation of the value of what had been lost to the environment. Had an appropriate deduction been made for the value of defensive expenditures, then GDP would not have grown significantly because of the accident and Alaska would have had a more realistic indicator of how well the economy was really doing.

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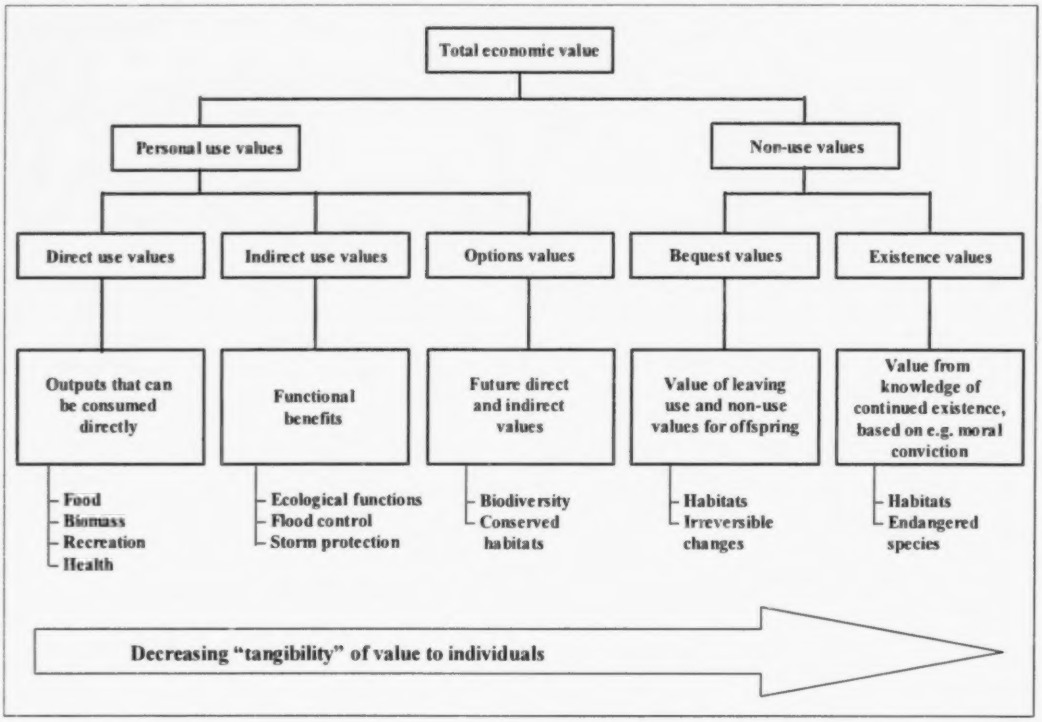
[42] See Reppeto and Gillis (1988).

In response to these anomalous results, several efforts have been made to make adjustments to the economic accounts in order to create an Index of Sustainable Economic Welfare (ISEW) and a Genuine Progress Index (GPI)[43]. In order to do this, the economic value of non-market uses of the environment must be determined. A conceptual framework to organize an approach to such measurements is discussed in the next two sections.

Total Economic Value

From an economic viewpoint, the value of any product or service is related to its usefulness to human society. Within organized markets the usefulness is assessed by the price people are willing to pay for them. However, there are functions in nature which are used by people and are not traded in markets, but clearly have value. Thus, in order to include non-market value, a conceptual framework that describes Total Economic Value (TEV) is needed. Figure G.1 presents the basic components of TEV which is initially partitioned into two categories: active personal use value and passive social use value.

Figure G.1: Total Economic Value


Total economic value
Personal use values
Non-use values
Direct use values
Indirect use values
Options values
Bequest values
Existence values
Outputs that can be consumed directly
Functional benefits
Future direct and indirect values
Value of leaving use and non-use values for offspring
Value from knowledge of continued existence, based on e.g. moral conviction
Food
Biomass
Recreation
Health
Ecological functions
Flood control
Storm protection
Biodiversity
Conserved habitats
Habitats
Irreversible changes
Habitats
Endangered species
Decreasing "tangibility" of value to individuals

Source: Munasinghe 1992

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[43] See Daly and Cobb (1989) and Colman (1998).

Active personal use value means that an individual or economic agent will either receive direct use value, indirect use value, or option value. When the outputs can be directly consumed, usually as a result of operating in a market, an individual derives direct use value. The benefits that arise from non-market ecological functions such as climate regulation, ozone layer protection or the waste processing capacity of nature constitute indirect use value. Sometimes an individual will be willing to pay, for example, for the maintenance of biodiversity because he or she wishes to have a future option to make direct or indirect use of nature.

Passive social use value is conceptually more difficult and includes bequest values and existence values. Bequest value suggests individuals may be willing to pay for non-market environmental goods or services in order to ensure that adequate stocks of resources and environmental functions are available for their children. An individual may assign existence value to distant and inaccessible elements of nature, *e.g.*, there is a willingness to pay for nature preservation just for the knowledge that it may continue to exist. The value expressed may be based upon altruism or a deeply held moral conviction.

When the value of nature to society is fully taken into account, the idea of Total Economic Value (TEV) is implicit. Figure G.1 also shows that movement from active personal direct use value to passive social existence value decreases the 'tangibility' of the value to the individual. It becomes both more difficult to define and more difficult to measure.

Approaches to Measuring Non-market Environmental Values

Because many of the ecosystem resources and environmental functions that are part of nature's TEV do not trade in markets, they do not have observable prices. Since prices are the market expression of consumer's willingness to pay for something, other ways must be found to infer a consumer willingness to pay for non-market goods and services.

There are a great variety of tools that are being applied; these range from relatively straightforward and objective valuation approaches that rely upon technical or physical observations to more complicated subjective valuation methodologies that are based on revealed or expressed behaviour. The literature dealing with these techniques has become very extensive in recent years[44].

In general, the approach to making any measurement of value involves four steps: (1) identifying important biophysical functions about which there is concern; (2) determining a damage function, *i.e.* how some external forces impact upon the critical biophysical function; (3) identifying measurable human impact that arises from the damage to nature; and (4) selecting a measurement tool that will provide a monetary expression of the damage.

Some part of TEV can often be calculated without great cost - for example, changes in productivity or cost of illness - but seldom all of it. Many of the techniques, especially subjective valuation approaches, require very expensive studies. This is frequently a barrier, so something called the environmental value transfer method has been used to avoid unaffordable studies. This method essentially adapts the quantitative results from studies conducted elsewhere as a reasonable indicator of value in the subject jurisdiction. A considerable literature has grown-up to support and suggest improvements to this cost-effective method of approaching valuation[45].

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[44] Three excellent primers on the topic include: Dixon, Scura, Carpenter and Sherman (1994), OECD (1995) and Pearce (1993). The technical literature runs into many thousands of citations.

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[45] See Brouwer (2000) for a recent state-of-the-art review of environmental value transfer method.

APPENDIX H

Glossary of Terms

APPENDIX H

GLOSSARY OF TERMS

Gross Domestic Product (GDP)

The measure of economic activity in an economy, in this case the Prince Edward Island economy. GDP measured on an expenditure basis is expressed as:

$GDP = C + G + I + (X - M)$

where:

C = Personal consumption (expenditure) of goods and services.
G = Government expenditures on goods and services.
I = Investment in capital, machinery equipment and inventories.
X = Exports of goods and services.
M = Imports of goods and services.

GDP is also measured on an income basis and consists of:

- labour income
- corporate profits before taxes
- interest and investment income
- net farm income
- unincorporated business income
- inventory valuation adjustment
- indirect taxes less subsidies
- capital consumption allowance

The Gross Domestic Product of an industry is the value-added by labour and capital in transforming inputs purchased from other producers into outputs.

Direct Contributions or Impacts

Direct contributions are defined as all ***'first round'*** economic activities which contribute to GDP, income and employment. These can vary from investment in a new or expanded fish processing facility to wages paid to employees directly involved in ocean-related activities.

Indirect Contributions or Impacts

Indirect contributions are defined as all ***'subsequent rounds'*** of economic activities which contribute to GDP, income and employment. These activities are not directly associated with the ocean activity but are a result of direct ocean-related activities. A good example of this are the inputs needed to build a fishing boat. The investment in the fishing boat is a direct ocean-related activity contributing to GDP (investment). The subsequent increase in demand for sawn timber (sawmills) and the increased demand for timber (logging) are indirect contributors to GDP. These indirect contributions also include ***'induced contributions'***.

Induced Contributions or Impacts

Induced contributions measure the economic activity associated with the re-spending of wages paid in the direct, indirect and, to a lesser extent, earlier rounds of induced activity.

Input-Output (I/O) Model

The Input-Output model measures the wide economic impact of a direct economic event by the known inter-industry dependency in the given economy. Different sectors of an economy depend on other sectors of the economy to supply its inputs or purchase its output to varying degrees. The imbalance in this supply/demand relationship is made up by imports ***(supply)*** and exports ***(demand).***

The Input-Output model measures total economic activity defined as direct + indirect + induced activities. For an explanation of direct, indirect and induced activity see preceding GDP definition.

Input-Output Tables

Input-Output tables list the supply (make) of commodities by industry, demand (use) of commodities by industry and final demand (personal expenditure, government expenditure, investment, exports and imports). In an Input-Output model which is closed with respect to households (includes induced impacts), households are treated as an industry.

These tables together with employment and GDP by Industry in the Input-Output system are used to produce impact multipliers for output, employment, household income and GDP.

Input-Output Multipliers

Input-Output multipliers relate the indirect and induced impact by industry to the direct increase or reduction of the output of a given industry. The sum of all industries' indirect and induced impacts plus the direct industry impact equals the total impact.

Multipliers are produced for output, income, GDP, and employment.

'Output Multipliers' relate the indirect and induced output impact to the change in direct output.

'Income-generated Multipliers' relate the change in household income to the change in output.

'Income-based Multipliers' relate the indirect and induced household income to the direct income associated with the change in output.

'Employment Multipliers (output basis)' relate the additional employment per output change.

'Employment-based Multipliers' relate the indirect and induced employment to the direct employment associated with the change in output.

'Value-added/GDP Multipliers'. These multipliers (coefficients) relate the additional GDP per output change.

Multipliers used for this study can be found in Appendix C.

Exports

Exports are defined as 'off-island' exports which include both inter-provincial and international exports. Where data constraints preclude the use of actual data, estimates were made and noted.

Full-time Equivalent (FTE)

Full-time Equivalent (FTE) used throughout this study refers to full-time equivalent employment. FTE employment converts seasonal or part-time employment into full-time employment by a factor of one full-time job for every 1.6 part-time job, unless otherwise stated.

Household Income

Household income is defined as all 'earned' income associated with the employment related to a given sector. The 1997-1999 average of provincial wages, salaries and supplementary labour income is used.

APPENDIX I

Bibliography

APPENDIX I

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